NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

AN ANALYSIS OF CLOSED-LOOP DETAILING IN THE NAVAL HELICOPTER COMMUNITY

by

Earl A. Crawford

March 2014

Co-Advisor: William Hatch
Co-Advisor: Chad W. Seagren

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REPORT DOCUMENTATION PAGE			*Form Approved OMB No. 0704-0188*
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.			
1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE** March 2014	**3. REPORT TYPE AND DATES COVERED** Master's Thesis	
4. TITLE AND SUBTITLE AN ANALYSIS OF CLOSED-LOOP DETAILING IN THE NAVAL HELICOPTER COMMUNITY			**5. FUNDING NUMBERS**
6. AUTHOR(S) Earl A. Crawford			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol number ____N/A____.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release;distribution is unlimited			**12b. DISTRIBUTION CODE**

13. ABSTRACT (maximum 200 words)

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This study examines the costs and benefits of retaining pilots in specialized squadrons for subsequent tours. Analyses are conducted of the current manpower and personnel distribution processes, and the development of funded requirements. Training cost estimates are reviewed, and historical helicopter pilot data are used to develop a steady-state Markov model capable of developing career progression data.

Closed-loop detailing does not offer the absolute solution for the HSC community in managing its manpower requirements and personnel distribution. However, placing an improved emphasis on tactical qualifications and mission performance will increase the community's mission capability while meeting career milestone leadership requirements.

14. SUBJECT TERMS Detailing, closed-loop, assignments, Additional Qualification Designation, aviation, helicopter, pilot, career			**15. NUMBER OF PAGES** 85
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UU

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

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AN ANALYSIS OF CLOSED-LOOP DETAILING IN THE NAVAL HELICOPTER COMMUNITY

Earl A. Crawford
Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 2003

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 2014

Author: Earl A. Crawford

Approved by: William Hatch
Co-Advisor

Chad W. Seagren
Co-Advisor

Bill Gates
Dean, Graduate School of Business and Public Policy

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LIST OF ACRONYMS AND ABBREVIATIONS

ACSB	Aviation Command Selection Board
ACWT	Air Combat Weapons and Tactics
ADHSB	Aviation Department Head Selection Board
AFSOC	Air Force Special Operations Command
AMCSB	Aviation Major Command Selection Board
AMD	Activity Manpower Document
AQD	Additional Qualification Designation
ARSOA	Army special operations aviation
ASUW	anti-surface warfare
ASW	anti-submarine warfare
BSO	Budget Submitting Offices
CNAF	Commander, Naval Air Forces
CNO	Chief of Naval Operations
CNP	Chief of Naval Personnel
CO	commanding officer
CPH	cost per flight hour
CSIS	Center for Strategic and International Studies
DMDC	Defense Manpower Data Center
DON	Department of the Navy
DSS	dedicated SOF support
FHP	Flight Hour Program
FRS	fleet replacement squadron
GWOT	Global War on Terrorism
HM	helicopter mine countermeasures
HMP	Helicopter Master Plan
HS	helicopter antisubmarine
HSC	helicopter sea combat
HSCWS	Helicopter Sea Combat Weapon School
HSL	helicopter antisubmarine light
HSM	helicopter maritime strike

ICW	interactive courseware
ITP	individual training plan
JPME	Joint Professional Military Education
LOR	learning objective reviews
MIW	mine warfare
MRC	Manpower Resource Code
NAVAIR	Naval Air Systems Command
NAVMAC	Navy Manpower Analysis Center
NOBC	Navy Officer Billet Classification
NPC	Navy Personnel Command
NSAWC	Naval Strike and Air Warfare Center
O&M, N	Operation & Maintenance, Navy
OPA	Officer Programmed Authorizations
PMA	primary mission area
PR	personnel recovery
ROC/POE	Required Operational Capability/Projected Operational Environment
RW	rotary-wing
RWWS	Rotary Wing Weapons School
SAS	Statistical Analysis System
SOAR	Special Operations Aviation Regiment
SOCOM	Special Operations Command
SOF	special operations forces
SQMD	Squadron Manpower Document
SWTI	Seahawk Weapons and Tactics Instructor
SWTP	Seahawks Weapons and Tactics Program
TAC	tactical
TF	total force
TFMMS	Total Force Manpower Management System
TMS	type/model/series
TYCOM	Type Commander
UIC	Unique Identification Code

ACKNOWLEDGMENTS

I would like to thank first and foremost my advisors, Bill Hatch and Chad Seagren. Without your special insights and persistent guidance, I would have never been able to produce this thesis. The knowledge I gained from your classes and advice were truly instrumental in giving me the tools I needed. Your impartiality and teaching virtue allowed me to work on a project that I had great interest in, making the entire process truly enjoyable and satisfying.

The results of this thesis would not have been possible without the very willing and helpful assistance of Rahul Pillay at Defense Manpower Data Center, CDR Brian Genton at Navy Manpower Analysis Center, and LCDR Steven Thomas at Navy Personnel Command. Your point in the right direction and knowledge greatly contributed to gaining the resources beneficial to this study.

Lastly, I must thank my wife, Abigail, for taking so much of the burden at home while I spent many long days and nights at the library. Your support and uncanny ability to do it all allowed me the time and focus to accomplish this task. I am truly blessed to always have you by my side.

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I. INTRODUCTION

On April 24, 1980, a joint military mission was launched to rescue 53 American hostages being held in Iran. Planning for the mission took five months and involved 14 aircraft requiring close coordination. Operation Eagle Claw ended in catastrophe. Three of the helicopters had to abort due to mechanical issues. Once the mission was terminated, two other aircraft collided and were destroyed, resulting in multiple casualties. The massive failure prompted the establishment of the 160th Special Operations Air Regiment, which trains and operates special helicopter units in conducting highly skilled missions (Ball, 2012).

Certain professions within the Navy require intensive training periods, which entail vast amounts of resources to achieve a specific skill level. Helicopter pilot is one such profession, and when the required skill level is increased, the training process must be extended, and it becomes even more expensive. A small community of naval helicopter squadrons requires this increased skill level in support of special operations forces (SOF). In order to receive the necessary skills and maximize the use of that training, individual officers must be assigned to these squadrons for a longer period than a conventional helicopter pilot assignment.

A naval helicopter pilot's career may follow two distinct paths. The first is a diversified one whose goal is to develop well-rounded officers capable of handling increased responsibility (PERS-43, 2013). The career milestones of these pilots are orchestrated by Navy Personnel Command (NPC) through assignment and placement officers. Assignment and placement officers manage manpower and personnel needs throughout the fleet by balancing professional development with the requirements of the Navy.

The second track enables officers more flexibility in their selection of job assignments. This career track does not traditionally follow operational commitments, nor does it offer the required balance between flying and non-flying tours. As a result,

individuals who choose to follow their own path may be limiting their opportunity for promotion.

Neither path provides the time to stimulate enhanced skill levels. A third option that encourages a sufficiently well-rounded career to offer longevity and provides the opportunity to acquire the necessary skills and experience within these unique helicopter squadrons may be required. A tailored career track or closed-loop detailing process would retain properly qualified individuals within a narrow set of assignment options. Their flying assignments would be limited to the community of SOF support squadrons and their non-flying jobs would be similar to obligations required by NPC, but tailored to their specialty skills.

The helicopter community spreads pilot quality across squadrons so that skill and experience are balanced evenly throughout the fleet. This balanced force maintains an equal capability of all the squadrons, each of whom is required to maintain similar levels of readiness. The balance of talent also supports NPC's goals of ensuring officers meet career milestones while filling essential jobs throughout the Navy. In some cases, however, special missions require the need to maintain a high level of skill and experience, sometimes at the expense of providing ideal career paths for every pilot in the community. The issue is sub optimizing the helicopter community's quality spread by limiting specially trained pilots to a closed-loop career path.

A. PURPOSE

The purpose of this research is to determine the first- and second-order effects of retaining specifically qualified helicopter pilots within a tailored career track. By understanding the effects of straying away from the traditional detailing path, an argument can be made for increasing the overall mission capability of special squadrons, while maintaining a required mission effectiveness of all squadrons. In addition, analyzing the costs and benefits to all pertinent stakeholders is instrumental in justifying any deviation from the current process.

Instituting a specially tailored career track may not only have consequences for the Navy. As discussed earlier, there may be implications on an individual officer's

career. A comparison analysis distinguishes the costs and benefits associated with choosing either career pipeline. If similar milestones can be met in either career path, officers might be less reluctant to branch out from conventional assignments.

B. RESEARCH QUESTIONS

1. Primary Question

- How do the costs and benefits of a closed-loop career path compare to those of a diversified pipeline?

2. Secondary Questions

- Who are the stakeholders and what are their primary concerns with both detailing models?
- What is the impact of increasing the naval aviator inventory to 50% rotary-wing pilots?

C. SCOPE AND METHODOLOGY

In order to analyze the possibility of sending specifically qualified helicopter pilots to special squadrons, a thorough examination of the current detailing process is conducted. This examination begins with developing an understanding of manpower and personnel requirements for the helicopter community within niche mission areas. Through the aviation community manager, placement officers, and assignment officers, the billets for these squadrons can be given a comprehensive examination into how they are filled with qualified inventory. Additionally, the preferred pilot career paths illustrate which milestones must be met to remain competitive for promotion.

An analysis of helicopter pilot data specifies transition flows throughout an individual's career may pertain to rank and flying status. The models assist in illustrating pilot career progression. They also provide data points for forecasting future requirements.

An examination of two different career tracks demonstrates differences in the costs and benefits as they relate to the entire community and individual squadrons. The benefits are measured in terms of attainment of highly skilled qualifications, while the costs are classified by a reduced number of individuals that can be available for

promotion and the needs of the Navy. The primary focus is on determining the costs associated with training each pilot to a specific level.

The benefits of a diversified career path are compared to those of a closed-loop detailing process. This assessment involves a look into the impact of human capital investments. Maintaining a highly skilled labor force in one area has repercussions on promoting well-rounded and experienced leaders. On the contrary, providing limited special training reduces the overall effectiveness of the entire organization.

D. ORGANIZATION OF STUDY

This thesis is organized in five parts. Chapter I contains the introduction. Chapter II provides the background of the Helicopter Sea Combat (HSC) community and how it is associated with the detailing process. Chapter II includes a review of pertinent instructions on manpower and personnel as well as literature on maximizing human capital through different career pipelines and training opportunities. Chapter III outlines the quantitative and qualitative tools used to determine the costs and benefits associated with different career paths. Chapter IV illustrates the results gathered from models and analyses utilized. Chapter V concludes the thesis with a summary, conclusion, and recommendations based on the research questions and further recommended research.

II. BACKGROUND / LITERATURE REVIEW

A. INTRODUCTION

The Navy has formal processes that provide the framework for executing the helicopter pilot career path. These processes ensure squadron pilot billets are optimally manned. The experience a pilot gains between particular assignments constitutes a career path execution of Navy work. The next step is piecing together how an officer is supposed to progress through their established career milestones. During a pilot's career, an emphasis is placed on attaining aircraft qualifications. Qualification proficiencies play an important role in defining a pilot's knowledge, skills, and abilities in support of mission capabilities. Based on the organization and various missions of the Navy's helicopter community, particular positions require varying skills, which may necessitate discriminating between pilots with different skill sets for assignments to various squadrons. Last, the practice by which the United States Army utilizes Aviation Warrant Officers illustrates the benefits of keeping highly trained pilots in flying jobs versus allowing them to branch out into other sectors of their service.

An abundance of literature exists that addresses the need for a tailored and diversified career track. This literature review incorporates the importance of skilled labor and a differentiation between general and special training. The costs and benefits of a diverse versus private career path are examined as they relate to the civilian sector. Finally, a look into the expanded requirement for special operations capable helicopters demonstrates a need to encourage the retaining of those aviators that acquire these qualifications.

B. BACKGROUND

The background provides a foundation on how the helicopter community is organized. This foundation includes the processes for training, attainment of qualifications, and how pilots are assigned to specific billets. The background also serves to narrow the focus of the study. Analyzing the entire Navy helicopter community would prove too wide a scope for the purposes of this thesis.

1. Manpower and Personnel Management

> Total Force (TF) manpower management is the methodical process of determining, validating, and using manpower requirements to inform budget decisions; prioritizing manpower authorizations based on available funding and personnel executability; and translating authorization into a demand signal for personnel, training and education processes. (Chief of Naval Operations [CNO], 2007, p. 1-1)

The process of assigning specific people to specific assignments for the Navy begins with determining the mission required by each unit or command. These missions are designated by the Navy to fulfill the National Security Strategy and National Military Strategy. Each mission platform has specific manpower requirements, which leads to the authorization of a manpower billet. In order to execute the mission, these billets must be filled with the correct quantity and quality of personnel. However, budgetary constraints and personnel availability may limit the amount of spaces that can be filled (CNO, 2007). Once specific billets are funded, Navy Personnel Command (NPC) begins the planning and distribution process (Hatch, 2012). Community managers establish the demand signal while placement and assignment officers execute the matching of personnel inventory to funded requirements (Chief of Naval Personnel [CNP], 2003).

a. Navy Manpower Analysis Center

For deploying units, the manpower required is based on the unit specific Required Operational Capability/Projected Operational Environment (ROC/POE) document. These documents delineate the mission sets a unit is required to embark on given a certain level of readiness as well as the expected environment the unit operates. The Navy Manpower Analysis Center (NAVMAC) examines the total workload required to meet the tactical, maintenance, training, and acquisition standards expressed in applicable directives and publications. Following an on-site visit (if required), they produce a draft Squadron Manpower Document (SQMD) for review by appropriate Type Commanders (TYCOM) and associated stakeholders. In some cases, squadron commanders may receive a draft to express any pertinent issues. Upon review, the Director, Total Force Requirements Division (CNO [N12]) approves the document and sends it back to NAVMAC to be loaded in the Total Force Manpower Management System (TFMMS). The SQMD

outlines the minimum manpower requirements for the applicable type/model/series (T/M/S) squadron to perform their wartime mission. The appropriate Budget Submitting Offices (BSO), in concert with TYCOMs, decide which of these requirements can be funded based on fiscal constraints, which yields a squadron specific Activity Manpower Document (AMD). The final product produces the billets authorized, or funded manpower a squadron is allocated to meet mission requirements (CNO, 2007; Code 30, Aviation Manpower Requirements Department, Navy Manpower Analysis Center [Code 30], personal communication, January 27, 2014).

b. Community Manager

Officer community managers are responsible for monitoring the health of their communities based on the Officer Programmed Authorizations (OPA) document, which details current and projected requirements. They determine the “executability” of SQMDs and route approval or needed changes to NAVMAC (CNO, 2007, p. 1-1). Through programming, community managers bridge the gap between determining requirements and planning for recruitment, education, and training. The cycle of balancing what billets are authorized against available funded personnel leads to distribution throughout the community (Hatch, 2012).

c. Placement Officers

Two factors need to be considered to properly distribute personnel to jobs in the Aviation Officer Community. One represents the needs of the command and the other works to fulfill the desires of the officer. Placement officers represent the commands’ interest in being manned to the correct level (PERS-43, 2013). Based on the squadron’s AMD, a placement officer can note all of the funded requirements and any associated prerequisites. These prerequisites include rank, designation, Additional Qualification Designators (AQD), and Navy Officer Billet Classification (NOBC) Codes. NOBCs typically define the duties of the job title and AQDs fine tune the requirement with any additional skills needed to accomplish the job (Chief of Naval Personnel [CNP], 2014).

Placement officers work closely with commanding officers (CO) to forecast billet openings and ensure it is filled by a qualified individual at the incumbent’s rotation point.

These billets are posted and monitored until they are filled. In the case of helicopter squadrons, individual officers may have additional qualifications not required to fill the billet. In order to provide an even spread of quality throughout the community, placement officers informally monitor these qualifications and assess the needs of the squadrons through dialogue with the COs (PERS-433J, HM/HSC/HT/TACRON Placement Officer [PERS-433J], personal communication, January 28, 2014). The result should be an optimally manned squadron.

d. Assignment Officers

More commonly known as detailers, these individuals represent the interest of the officer while filling the authorized manpower requirements of the squadrons. While placement officers monitor the timing of billets becoming open and closed, assignment officers maintain a close look at the timing of personnel as they transfer to and from their duty stations. They work directly with the individual officer to examine what available jobs coincide with prescribed milestones in their career paths

As representatives of their respective communities, they are the direct liaison between the individual and a potential assignment. Their job is not limited to providing options that represent the personal interests of the officer. They must also ensure career interests are fulfilled that enable the officer to promote (CNP, 2003). Part of this mission is accomplished by providing balanced advice on the costs and benefits of accepting a particular assignment (PERS-43, 2013). Assignment officers are the key to ensuring career milestones are met in accordance with pre-established career paths.

2. Aviation Career Path

The manpower and personnel management process appears to only address the creation of assignments and transferring of officers to fill those assignments. There are many other factors that play an important role in determining when an officer is eligible and qualified for a particular job. “Operational career milestones give every aviation officer the opportunity to develop a pattern of sustained superior performance within the officer’s warfare specialty” (PERS-43, 2013, slide 7). Although NPC does take personal

preferences into account, they must always prioritize professional development and filling fleet requirements.

a. Sea / Shore Rotation

A major factor in determining fleet requirements is prescribed sea/shore tour lengths. Set by the Secretary of the Navy, this requirement mandates explicit timeframes that officers shall remain in sea tours as well as recommended periods to be assigned for shore tours. Article 1301-110 of the Naval Military Personnel Manual delineates these times and allow for variation based on community constraints (Chief of Naval Personnel [CNP], 2004). The timeframes shown in Table 1 allow warfare communities to adjust their own prescribed sea/shore rotation cycles in order to match the current and projected inventories of designated officers with fleet requirements.

Rank	Tour	Description	Sea	Shore	Remarks
ENS LTJG	Input	Pilot/NFO Training			Variable based on community and designator.
LT	Initial Sea	Fleet Squadron Tour in warfare specialty	36-42		Exclusive of FRS, variable based on community and designator.
	First Shore	TRACOM, FRS, PG School, Staff, CRUITCOM, Washington, etc.		24-36	Variable based on billet.
	Second Sea	Squadron, Ship's Company, Embarked Staff	24		Exclusive of FRS.
LCDR	Third Sea	Squadron Dept Head	24-30		May be reduced to 24 months or O-5.
CDR	Second Shore	Staff, Joint, Washington, Subspecialty		24-36	May be reduced for Command selectees.
	Fourth Sea	Command XO/CO	24-36		Variable by community.
	Third Shore	Post command		36	Variable based on billet.
CDR	Fifth Sea	Ship's Company	24		
CAPT	Sixth Sea	Major Command, CV/LHA Command	18		
		Ship's Company, VP Wing Command, CVW Command	24		
		CVN Command	36		
	Fourth Shore	Major Shore Command Minor Shore Command		24	
		Other shore		36	

Table 1. Aviation Officer (13XX) Tour Lengths (from CNP, 2004)

b. Goal of Preferred Career Path

Within the context of this thesis, a preferred career path represents the ideal set of assignments that will lead to the promotion of a naval helicopter pilot. In this case, the primary stakeholder is the officer, but the Navy still has a very big claim as to how a career progresses. The Navy's intentions are to implement their own values in order to fulfill their needs while providing a guideline for officers to prosper throughout their career.

According to NPC, the goal of assignment officers is to keep pilots on a career path for promotion to commander. This achievement takes approximately 15 years and accomplishes two objectives (PERS-43, 2013). First, the officer receives the obvious benefits that go along with promotion such as increased responsibility and pay. More importantly, the Navy is fostering the growth of its future leadership. Therefore, it is imperative that NPC keep officers on a path that would produce an officer worthy of greater responsibility.

Another goal of a preferred career path is to ensure the values of the aviation community are maintained through future leadership. The community knows to what level it wants officers to branch out and gain experience in other specialties. There are also milestones within the community that are valued more than others. Therefore, including those types of assignments in one's career are held in high esteem (PERS-43, 2013).

c. Milestones

The aviation community has constructed two distinct parts to an aviation career path. The first part identifies where an officer is in the sea/shore rotation cycle. This part is mandatory and can only be altered under certain circumstances (CNP, 2004). The second part involves a little more flexibility. Depending on whether an aviator is up for a sea or shore assignment, otherwise referred to as a tour, there are a variety of different jobs required to be filled. The preferred career path of a naval helicopter pilot is illustrated in Figure 1. Blocks in yellow indicate the mandatory sea/shore rotation cycle

to include flight school. The blocks in blue specify some of the general types of jobs that fall under their respective part of the cycle (PERS-43, 2013).

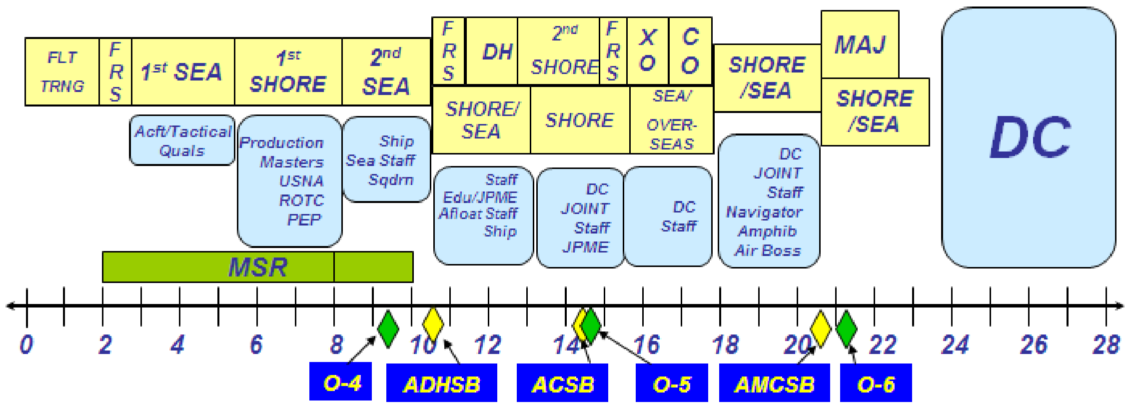

Figure 1. Aviation Career Path (after PERS-43, 2013)

Upon graduating flight training, officers receive official designation as a 1310, Naval Aviator. Pilots are then sent to the applicable Fleet Replacement Squadron (FRS) to receive training on their type/model/series (TMS) aircraft. They then proceed to their operational squadron to complete their first sea tour. The focus of this tour is on developing aircraft and tactical qualifications while administratively performing duties as a division officer. The tour typically last three years, and pilots proceed to their first shore tour where they may operate in a non-deployable flying status such as a training squadron or a non-deployable, non-flying status such as attending Naval Postgraduate School. The second sea tour, commonly known as a "disassociated sea tour," usually involves branching out from the community in order to gain a diversified background. Performance through evaluation, peer competition, and attainment of qualifications, as well as assignment selection during these tours are the criteria used for selection boards. These boards determine whether an aviator will continue their naval career and what direction that career will take them (PERS-43, 2013).

Aviators must pass statutory and administrative boards in order to continue their careers. The timing of these boards is shown in dark blue in Figure 1. The purpose of statutory boards is to determine promotion in rank. The board is composed of unrestricted

line officers from all over the Navy, not just aviators. Administrative boards determine selection for particular career milestones. Board members only come from the aviation community. The milestones are the Aviation Department Head Selection Board (ADHSB), the Aviation Command Selection Board (ACSB), and the Aviation Major Command Section Board (AMCSB). For this thesis, the primary focus is on the first two. Statutory boards determine longevity in service and administrative boards determine direction. All future milestones require the completion of previous ones to include promotion (PERS-43, 2013). Retention plays a crucial role in determining the criteria by which board numbers make selection. Low retention leads to a smaller pool of applicants, hence, lower standards for selection.

There are two criteria for determining which assignments make an aviator more competitive for promotion. The first are precepts, which are used to determine board eligibility. These are minimum requirements set forth by applicable laws and instructions that govern the United States military. One example is the prerequisite for senior leadership to be joint qualified as set by Title 10 of the United States Code. In order to be joint qualified, an officer must have served a tour in a joint assignment following completion of an approved Joint Professional Military Education (JPME) course (Armed Forces, 2006). In order to meet these precepts to be eligible for the ACSB, an aviator needs to choose assignments that meet these obligations.

The second criterion is based on statistical analysis from previous boards. The placement and assignment officers are responsible for providing feedback on selection board results. Selection rates are calculated for performance, qualifications, and assignments completed. The fiscal year 2014 ADHSB resulted in 73% selectees having attained a master's degree and 89% having completed JPME. Of the non-selectees, only 61% had master's degrees and 75% had JMPE completion certificates. Production squadrons' assignments (i.e., Fleet Replacement Squadron, Helicopter Training Squadron) also have a positive effect on selection board results. Of those selected, 50% had completed assignments at a Fleet Replacement Squadron whereas 43% were non-selects. Performance plays a crucial role in being selected by these boards, but job selection is the best metric for formulating the preferred career path. Understanding how

to incorporate assignments that maintain a high skill level in the cockpit as well as meeting the goals of the Navy will lead to optimal career progression (Commander, Naval Air Forces [CNAF], personal communication, October 15, 2013; PERS-433J, personal communication, January 28, 2014).

d. Closed-Loop Detailing Model

A closed-loop career path does not necessarily suggest that an officer is detailed to the same unit for their entire career. Capitalizing on the training investment is the primary concern, but not at the expense of denying pilots the ability to promote. The model generates the opportunity for pilots to be assigned to the dedicated special operations forces (SOF) squadrons, HSC-84 and HSC-85, as a junior officer. If the pilot becomes fully mission qualified at the squadron and receives the appropriate AQD, they would become a primary candidate to be closed-loop back to HSC-84/85 for department head. If they are assigned to the squadrons in place of their first shore tour, their second sea tour should be utilized to take advantage of their special expertise. This tour might involve assignment to other SOF units within the service or as a joint tour. The experience acquired might best serve the helicopter community by taking assignment as an instructor at one of the various schools. The possible career paths are shown in Figure 2 and incorporate how closed-loop detailing would only represent a small deviation from the preferred track.

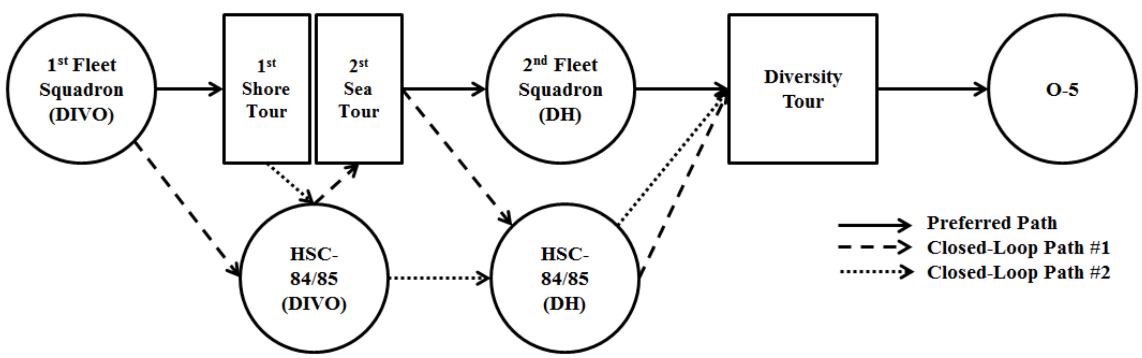

Figure 2. Closed-Loop Career Paths

Through the rank of O-5, expected time spent in flying billets and non-flying billets is approximately equal. Due to sea/shore rotation requirements, a pilot in either model serves in at least three deployable fleet squadrons: division officer, department head, and commanding officer. The time spent between these tours is utilized to diversify the background of a helicopter pilot through assignment at training squadrons, disassociated sea tours, and staff tours. The closed-loop detailing model increases the opportunity for attaining experience during an additional deployable fleet squadron tour, but offers the opportunity to rejoin the preferred career path at various points. Those pilots that have stayed on the preferred career path through their second sea tour would not be candidates for department head at HSC-84/85 as they would prove much less effective, unless they were to stay there for subsequent tours. This notion does not apply to those that transfer to the squadrons as full time support or selected reserve personnel since they have the opportunity to remain at those squadrons for longer periods of times.

3. Training and Qualifications

A helicopter pilot can be evaluated in two forms of human capital. First, they are evaluated by their performance on the ground as an officer. Squadron commanding officers evaluate each pilot based on the jobs and tasks they perform, longevity in the squadron, and the quality of the leadership they provide. These reports weigh heavily on the selection boards previously discussed, but are not the focus of this study. The second form of measuring human capital with regards to pilots is their ability to accomplish aerial missions in the aircraft they are assigned. This form is measured by attainment of aircraft qualifications through rigorous and lengthy training pipelines. Some qualifications pertain to basic operation of the aircraft and are attained during an aviator's first squadron sea tour. Authority to designate pilots in these qualifications lies with the CO. Failure to attain these credentials likely results in failure to be promoted. A better measure of skill level in the aircraft is with tactical qualifications. They require more resources and can be directly related to a squadron's mission. A lack of tactical qualifications does not necessarily mean a pilot does not possess the ability to acquire these skills. In some cases, squadron resources, operational tempo, or a pilot's timing in

the squadron may preclude them from getting the opportunity to accomplish the training syllabus. This research defines skill level as the capacity to perform specific missions by completing an approved training syllabus.

a. Seahawk Weapons and Tactics Program

The Type Wing Commanders’ Instruction 3502.5A encompasses the entire tactical training regimen of the Helicopter Sea Combat (HSC) Community. It is a multiparty instruction in that it falls under the authority of the HSC Wing Commander on the West Coast and their counterpart on the East Coast. The instruction is the result of fulfilling Commander, Naval Air Force’s (CNAF) requirement of all type wing commanders to create an Air Combat Weapons and Tactics (ACWT) training syllabus. The intent is to standardize the tactical qualification process for all HSC squadrons (Commander, Helicopter Sea Combat Wing, U.S. Pacific Fleet [CHSCWP] & Commander, Helicopter Sea Combat Wing, U.S. Atlantic [CHSCWL], 2012).

The Seahawk Weapons and Tactics Program (SWTP) differentiates tactical qualifications based on levels and mission areas. It also distinguishes the process by which these designations can be achieved. There are five levels of proficiency within the syllabus. The first is completed upon graduation from the Fleet Replacement Squadron. Level II through IV is gained through training conducted at the squadron level with guidance and assistance from an HSC Wing Commanders’ respective Weapon School. The HSC Weapon School (HSCWS) is comprised of pilots who have gained qualification level V from the Naval Strike and Air Warfare Center (NSAWC) Rotary Wing Weapons School (RWWS) Seahawk Weapons and Training Instructor (SWTI) course. The course is taught by pilots who have already gained the level V qualification. Level IV (I) is reserved for graduates of the SWTI course who are not attached to one of the HSCWS or the NSAWC RWWS (CHSCWP & CHSCWL, 2012). Table 2 distinguishes the potential level and mission area qualifications.

Level	Designation Authority / Description
I	FRS / Completed syllabus
II	Squadron CO / Tactical Copilot (per PMA)
III	Squadron CO / Tactical Aircraft Commander (per PMA)
IV	Squadron CO / Tactical Mission Commander (per PMA)
IV (I)	NSAWC RWWS / SWTI (all PMAs) *not assigned to HSCWS or NSAWC RWWS
V	NSAWC RWWS / SWTI (all PMAs) *assigned to HSCWS or NSAWC RWWS
Primary Mission Areas (PMA): ASW (HS only), ASUW, PR, SOF, MIW (Pending), DSS (HSC-84 / 85 only)	

Table 2. SWTP Level / PMA Qualifications

Training syllabi are divided by mission sets, or Primary Mission Areas (PMA). A pilot can gain different levels of qualification within any of the six PMAs: Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASUW), Personnel Recovery (PR), Special Operations Forces (SOF) Support, Mine Warfare (MIW), and Dedicated SOF Support (DSS). The DSS PMA can only be trained for by those squadrons deemed by the HSCWS to be specifically assigned that mission set. Currently, HSC-84 and HSC-85 are the only squadrons permitted to train to the DSS PMA. Unlike other PMAs, DSS requires level qualification in the ASUW, PR, and SOF PMAs in order to acquire the same level qualification through the Tactical (TAC) syllabus. The TAC syllabus has additional training requirements to those necessary in the ASUW, PR, and SOF PMAs (CHSCWP & CHSCWL, 2012).

Gaining qualifications within any of the PMAs requires that mission-specific ground training, simulator training, and flight training be completed prior to designation. Ground training incorporates Interactive Courseware (ICW), Learning Objective Reviews (LOR), exams, and oral boards. Simulator and flight training involves a program of flight cards to be completed by the trainee. Each flight card, or grade card, involves completing specific simulator or flight objectives that fall under their respective PMA (CHSCWP & CHSCWL, 2012).

Initial designation requires the completion of all the prescribed requisites. Expiration of qualifications can occur for level III designations and higher. If expired, the

individual need only complete the exams and a standardization flight for the respective PMA. In addition, a training jacket review must be conducted by the squadron in order to determine if any other training requirements are needed. These requirements hold true for transitions from other squadrons. For the DSS PMA, HSC-84/85 require the formulation of an individual training plan (ITP), which devises all training requirements for the TAC syllabus. Based on prior PMA-level qualifications and mission experience, the ITP is tailored to the individual in order to optimize the time and cost to train (CHSCWP & CHSCWL, 2012).

For the purposes of this study, the focus on the training requirements is narrowed to attainment of specific qualifications. The Level III qualification entitles a pilot to act as aircraft commander in exercises and operational missions for the appropriate PMA. Level III also allows them to act as instructor for flights involving Level III and below grade cards. In order to develop cost and time estimates to train, the ASUW, PR, SOF, and DSS PMAs are analyzed. As mentioned earlier, the ASUW, PR, and SOF Level III designations are required prior to commencing the DSS, or TAC Level III syllabus. Therefore, two different training pipelines are compared. For aviators in HSC squadrons, other than HSC-84/85, the training required to achieve ASUW Level III, PR Level III, and SOF Level III is calculated. For HSC-84/85, qualification as a TAC Level III pilot is examined. The second pipeline looks at the additional training required for a pilot transitioning to HSC-84/85 with Level III qualification in ASUW, PR, and SOF.

b. Additional Qualification Designations

The 1310 designation is reserved for unrestricted line officers who are qualified for duty as a pilot. In order to identify additional skills, qualifications, and knowledge, Additional Qualification Designations (AQDs) are assigned based on the specialty gained by pilots. AQDs can also be used for manpower authorizations when attached to requirements for certain billets. AQDs can pertain to specialty skills other than aircraft qualifications, but these are not the focus of this study. AQDs use three character identifiers to code a specific attribute. Those that begin with the letters “D” and “E” are

reserved for AQDs involving aviation warfare. The second and third character further specifies and differentiates the type of qualification (CNP, 2014).

Pilots who have received qualification to operate helicopters may gain the DY0 or DW0 AQDs. Other AQDs for helicopter pilots define various designations as an approved instructor pilot or student. The rest are distinguished by tactical qualification in specific aircraft. This study's concern is with those required to operate helicopters in the HSC Community in the tactical environment. DW9 describes pilots qualified as Level III Combat Search and Rescue in the HH-60H aircraft. This qualification equates to the Level III PR designation in the SWTP. DWC is the same qualification, but for the MH-60S aircraft. Examination of the *Manual of Navy Officer Manpower and Personnel Classification* shows that many of the AQDs given to helicopter pilots are not synchronized with the nomenclature of qualifications in the SWTP (CNP, 2014).

Typically, qualifications gained are documented in a pilot's training jacket to be used for redesignation purposes as pilots transfer between squadrons. For billet descriptions, tactical AQDs are seldom used and resort to the DY0 or DW0 AQDs. The DWE AQD is the only qualification that matches the classifications used in the SWTP. It designates pilots who have attained TAC Level III or higher at HSC-84/85 (CNP, 2014). The DWE AQD is also utilized for manpower authorizations on billets. Currently, only the HSC-84 AMD refers to billets by this AQD (Navy Manpower Analysis Center [NAVMAC], 2013b).

Placement and assignment officers are limited in their ability to man squadrons with an equal level of tactically qualified pilots due to the inaccuracies of the current system. They must informally discuss qualifications with commanding officers and the individual being detailed to acquire the necessary knowledge (PERS-433J, personal communication, January 28, 2014). Until HSC-84's AMD was updated and the pilots were properly assigned the DWE AQD, the squadron would receive pilots that required a much more extensive training syllabus. Timing and availability always play an important role in manning squadrons with an adequate amount of tactically qualified pilots, but matching AQDs to the qualifications used in the SWTP and updating AMDs for all HSC squadrons will ensure an even distribution of skill level across the community.

4. Helicopter Community

The Navy's helicopter community has undergone a major reorganization in the past 15 years. In the late 1990's, the Office of the Chief of Naval Operations (CNO) developed the "Helo Master Plan" (HMP). The purpose of the HMP was to consolidate the different types of helicopters the Navy used and refocus the missions of these new communities (Brennan, 1998, p. 6). Figure 3 illustrates the transition and timeframe in order to complete the restructuring. The Navy's HMP is near completion with only a few of the legacy units left in operation. Concentrating on the current status of the Navy helicopter force, the requirement for specific skill sets can be more easily understood.

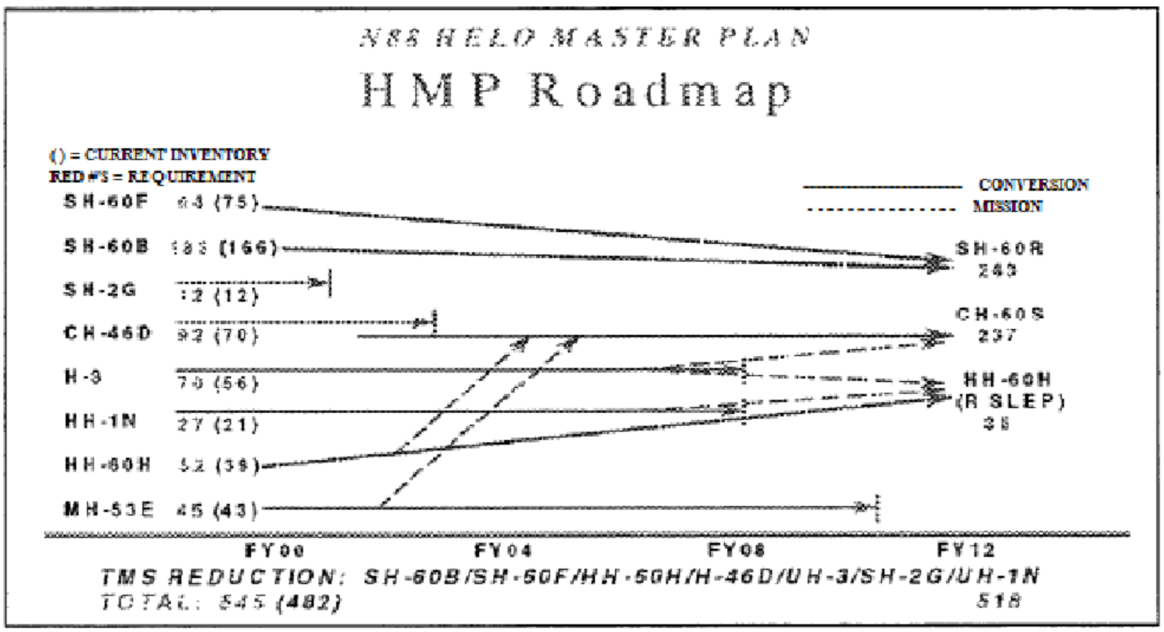

Figure 3. Helicopter Master Plan Roadmap (after Lopez, 2000)

a. Organization

Three separate Naval Postgraduate School master's theses detail the Navy's initiation of the HMP (Brennan, 1998; Hoeft, 1999; Lopez, 2000). At the time, the Navy had eight different helicopters varying by TMS. The goal was to combine mission sets of the different helicopter communities, discontinue the use of outdated aircraft, and begin using only three aircraft. The final three would be two new aircraft and one legacy

aircraft. In addition, they would be the same type and model and only vary by series, greatly increasing the interoperability of the new communities and driving down maintenance and training costs.

Since the initiation of the HMP, four aircraft have been discontinued (SH-2G, CH-46D, H-3, HH-1N). Some squadrons still possess the SH-60F and SH-60B, but are awaiting implementation of their phase out plans. Termination of the MH-53E is pending completion of mission trials by the MH-60S. Table 3 depicts the current status of the helicopter communities.

Community	Deployment Status	Aircraft	Status
HSC	Carrier Force	MH-60S	Current
	Expeditionary	MH-60S	Current
	Expeditionary - Reserves	HH-60H	Current
HSM	Carrier Force	MH-60R	Current
	Expeditionary	MH-60R	Current
	Expeditionary - Reserves	MH-60R	Current
HS	Carrier Force	SH-60F / HH-60H	Awaiting transition to MH-60S
HSL	Expeditionary	SH-60B	Awaiting transition to MH-60R
HM	Expeditionary	MH-53E	Awaiting mission capability trial of MH-60S

Table 3. Helicopter Community Status

Squadrons are organized into wings and defined by their deployment status and aircraft. The East and West coasts each have a HSC wing and a Helicopter Maritime Strike (HSM) wing, comprising all helicopters under CNAF. Currently, Helicopter Anti-Submarine (HS) squadrons and Helicopter Mine Countermeasure (HM) squadrons fall under the authority of their respective coasts' HSC wing and are awaiting transition for their nomenclature to change. Helicopter Anti-Submarine Light (HSL) squadrons operate under their respective HSM wing and are awaiting the same transition. Eventually, only two communities will remain, HSC and HSM, and the HMP will be complete. Each will have squadrons capable of either operating in support of carrier forces as a whole squadron, or be expeditionary detachments (Jackson, Munson, & Peacock, 2012). The only anomalies are the HSC expeditionary reserve squadrons (HSC-84 and HSC-85), which utilize the HH-60H in direct support of special operations forces (Department of the Navy [DON] & United States Special Operations Command [SOCOM], 2010).

b. Mission

As previously discussed, this study's focus is limited to those squadrons operating in the HSC community. Although HSC units deploy in conjunction with HSM units in support of similar mission sets, the priority of these mission sets differ. The HSM community utilizes the capabilities of its MH-60Rs for "Anti-Submarine Warfare, Anti-Surface Warfare, Surveillance, Communications Relay, Combat Search and Rescue, Naval Gunfire Support and logistics support" (Naval Air Systems Command [NAVAIR], 2012a, para. 1). The HSC community relies on differing capabilities of the MH-60S for "Anti-Surface Warfare, combat support, humanitarian disaster relief, Combat Search and Rescue, aero medical evacuation, SPECWAR [special warfare] and organic Airborne Mine Countermeasures" (Naval Air Systems Command [NAVAIR], 2012b, para. 1). HSC-84 and HSC-85 are specifically tasked to support SOF and maintain their HH-60H aircraft for that mission set (CHSCWP & CHSCWL, 2012). All helicopters are capable of accomplishing a variety of other mission sets. Those listed above are the priority mission sets that lead to the development of their individual ROC/POEs.

5. Aviation Warrant Officer

Following World War II, the Department of the Army saw a drastic reduction in officer inventory. A large gap between requirements and available inventory began to form with the expansion of Army helicopter aviation. The solution was to utilize Warrant Officers to fulfill these new requirements at a reduced cost. In addition, high rotation rates of Army aviation officers led to instability and a lack of experience in the community. Warrant Officer pilots did not require a diversified career path, and therefore, were able to stay in a flying status throughout their careers (Warrant Officer Historical Foundation, 2013).

The Navy attempted a flying Chief Warrant Officer program in 2006, but it was terminated in 2013. Manpower issues drove the initiation of the program just as it did with the Army. The difference, however, was that the Navy's focus was to manage a growing accession rate of commissioned officer aviators rather than a diminishing one. The Navy's objective was to increase the inventory of pilots, but reduce the competition

for milestone achievement on statutory and administrative boards. Eventually, there was a reduction in naval aviator requirements, and the counter effect was not enough commissioned officer to successfully compete for those milestones (Faram, 2013). The Navy prioritized career progression more than the development of skilled and experienced pilots that would provide continuity in the aviation field.

C. LITERATURE REVIEW

Identifying the benefits and hurdles in developing and maintaining a skilled labor force are important. How much effort must an organization expend to restructure its own goals to foster a particular level of expertise? Estimating manpower requirements and maintaining qualifications is simply another instrument of human capital management. In both cases, there are limited resources and there are countless constraints. Competition for human capitol requires continuous scrutiny to maintain a desired level of effectiveness.

In developing an argument for the significance of managing human capital, consideration should be given to how this relates to the career of a Navy helicopter pilot. The construct of the literature is mostly based on evidence applied to the civilian sector and utilizes fundamentals pertinent to that workforce. These principles include the ability to employ and terminate human capital, challenges in retaining that human capital, and measuring the worth of that human capital.

Although a naval officer is “hired” at the beginning of their career and can be fired for negligence, the construct of the military’s manpower and personnel system is significantly different than the employment/termination processes of the civilian sector. Retaining personnel is also an issue for the Navy when individuals reach the end of their minimum service obligations and low unemployment, enticing job markets exists outside the military. The focus of this study, however, is on measuring competition within the Navy, as officers may laterally transfer to other communities or follow career tracks that prevent promotion in order to participate in assignments that deviate from the established norm. Lastly, an officer’s effectiveness or worth can be measured in a variety of ways. Leadership ability, task management, and production are just a few of the devices that

can be used to define officer potential. For the purposes of this research, qualification in the aviation warfare specialty is used to define the value of helicopter pilots.

1. Importance of Skilled Labor

Human capital refers to the people required to improve the competitiveness of an organization. Like all other forms of capital, a firm can manage their investments in order to foster optimal productivity (Elsdon & Iyer, 1999). Human capital can be measured by an individual's core competencies, otherwise noted as knowledge, skills, and abilities. Possessing employees that have higher levels of these core competencies ensure the "long-term success" of the firm (O'Connor, Bronner, & Delaney, 2002, p. 8). From the perspective of the helicopter community, these traits can be translated into a pilot's capability to perform aerial missions. If the community is to be successful, they must invest in their human capital with tactical training to ensure the highest degree of mission capability is maintained.

Elsdon and Iyer perform a study on retention of human capital as a "key source of sustainable competitive advantage for organizations" (1999, p. 39). Their focus is on nurturing employee retention through providing assistance in managing their careers with counseling. The methods utilized center around measuring performance following investment in the employee with specific services. Although the services do not relate to the type of investment in human capital in this study, one common theme is evident. Market advantages stem from capitalizing on the "unique strengths of the workforce," and failure to acquire, invest, and retain a certain level of skill will have consequences (Elsdon & Iyer, 1999, p. 46).

Another study places value on emphasizing performance by measuring education, experience, and skill level. Myers, Griffith, Daugherty, and Lusch (2004) utilize a survey instrument and statistical analysis to identify attributes that lead to the highest value of employee worth (p. 212). Employers assign this value based on the performance of the individual. The study finds that job experience and education level do not directly correlate to performance, yet, higher levels of job skill attainment lead to higher values on employee worth (Myers et al., 2004). These findings suggest that attainment of tactical

skill sets leads to increased performance and place a higher worth on pilots with these qualifications.

2. Special versus General Training

Training is used as an investment to enhance human capital. General training is conducted for highly transferrable skill sets. Specific training develops human capital in skill sets only pertinent to the organization providing the training. Issues arise when determining who pays for the training (Tick, 2013). In the Navy, all training is provided by the organization at no cost to the employee directly, although, training and qualification attainment are typically associated with promotion. Therefore, employees accept lower wages until training requirements and qualifications are fulfilled. This thesis attributes general training to those tactical skills transferrable to all squadrons in the HSC community. Special training investments can only occur at HSC-84/85 with regards to qualification in the Dedicated SOF Support PMA.

Since it is not reasonable to distinguish general and specific training by whether an employer or employee pays for the training in the Navy, another relationship can be applied that considers the implications. There are different incentives for HSC-84/85 to offer their special training, which can only be used while assigned to those squadrons. The squadrons are discouraged to provide general training in those qualifications that can be utilized at any HSC squadron. According to Kessler and Lülfesmann (2006), early theories suggest that firms do not contribute to general training for their employees in a competitive labor market. Their study attempts to refute these theories by illustrating firms that do pay for general training. One reason firms pay for general training is when employees possess specific skills because this increases the productivity of the worker. Likewise, if an employee possesses general skills, the firm may deem them qualified to attain specific skills, so as to prevent their attrition from the organization (Kessler & Lülfesmann, 2006).

If the Kessler and Lülfesmann theory holds true, HSC-84/85 is incentivized to invest in general human capital to make them more productive in the utilization of their specific skills. This notion is not very useful since pilots must have general qualifications

in the ASUW, PR, & SOF PMAs before they can acquire special qualification in the DSS PMA. On the other hand, if a pilot comes to HSC-84/85 with an adequate amount of general training completed, then there are very high incentives to invest in special training. The reasoning is not limited to acquiring another qualified pilot to accomplish their mission sets. This human capital investment should assists in retaining the pilot for their special skills since this skill cannot be used elsewhere.

3. Career Paths

According to Super (1957, p. 286), "a sequence or combination of occupational positions held during the course of a lifetime" define a career (as cited in Joseph, Fong Boh, Ang, & Slaughter, 2012). Joseph et al., attempts to further specify this definition by distinguishing a career by the path, mobility, and timing of movements between jobs. A career path can be organized in a traditional manner that results in advancement or an unconventional method that involves assignments across a wide range of organizations and job titles. Career mobility refers to these shifts, either across organizations, occupations, or both. The timing of these career moves illustrates the eagerness or reluctance of an individual to change their career path at different points in their career cycle (Joseph et al. 2012).

The concept of a "boundaryless career" refers to careers that branch away from traditional notions of how a career should progress (Becker & Haunschild, 2003). Becker and Haunschild suggest there are consequences for organizations where individuals engage in careers that deviate from the status quo. All of the consequences are based on the premise of "evaluative capacity" (Becker & Haunschild, 2003, p. 10). Individuals following a "boundaryless career" create uncertainty on their intentions and lack reference points from traditional career progression. In addition, their job selections lack achievement definition for employers to distinguish them from the rest of their peers. The article attempts to provide coping methods for organizations and individuals dealing with "boundaryless careers," but the consequences portray the reluctance of organizations in supporting career paths that diverge from traditional methods (Becker & Haunschild, 2003).

There is a difference between a diversified career path and a divergent one. The Navy promotes officers gaining experience across the communities in a diversified career track. A divergent path strays from the Navy's preferred one and makes it difficult for selection boards to evaluate performance. A traditional path is easier to measure and provides the community with the parameters to track an officer's progression.

4. Special Operations Forces Aviation Requirements

The Center for Strategic and International Studies (CSIS) issued a paper on the increasing need for SOF aviation assets in 2007 (Murdock, Grant, Comer, & Ehrhard). A working group of subject matter experts was convened to issue findings regarding the future of SOF aviation. The 2006 Quadrennial Defense Review (QDR) issued a need to expand SOF, but it did not place an emphasis on meeting the expansion with new aviation assets. Currently, Special Operations Command (SOCOM) is only able to fund upgrades to existing service assets even though the assets fall under their authority. Unless an entirely new airframe is to be solely used by SOCOM, it is the responsibility of the respective services to fund the acquisition process. SOCOM's budget has been increased drastically in past years, but it has not been compensated with the resources necessary to fund a new platform (Murdock et al., 2007).

Currently, the only aviation assets allocated to SOCOM come from the Air Force and Army. Air Forces Special Operation Command (AFSOC) maintains the majority of fixed-wing assets to include tilt-rotor platforms, and Army Special Operations Aviation (ARSOA), via the 160th Special Operations Aviation Regiment (SOAR) operates the majority of rotary-wing (RW) assets. The Global War on Terrorism (GWOT) has resulted in an over usage of current assets just as many of those platforms are reaching the end of their service life. Army, Air Force, Navy and Marine Corps SOFs rely on these Air Force and Army assets for training and operational commitments. According to the study, there are three main issues facing SOF RW aviation: fleet sizing to meet expanded SOF needs, inventory maintenance, research and development of new systems (Murdock, et al., 2007).

The former Commander of Special Operations Command, Admiral Olson, issued a memorandum to the CNO calling for institutionalizing RW support from HSC-84/85 (2009). Based on support provided to joint SOFs in Iraq, he stated that "assigning selected active and reserve RW assets in direct support of SOF for both training and deployed operations would positively resolve much of the current shortfall" (2009, para. 3). This call for additional RW support led to an overarching memorandum of agreement between DON and SOCOM requiring HSC-84/85 to shift their "primary mission set to dedicated SOF support" (DON & SOCOM, 2010, para. 3).

D. CHAPTER SUMMARY

The manpower and personnel management processes balance the inventory of helicopter pilots with the funded requirements. These requirements stem from a squadron's mission essential tasks via the ROC/POE and are limited by budgetary constraints and timing. The result is a complex cycle of transferring pilots between assignments while ensuring squadrons are manned to the optimal level. The needs of the Navy require a pilot to develop via a preferred career path by taking assignments that meet eligibility requirements and are deemed beneficial from the results of previous selection boards. These boards occur as milestones in an officer's career and determine promotion status and direction.

During their flying assignments, a pilot must excel in their warfare specialty. This involves attaining tactical qualifications in aircraft. Qualification designation is guided the Seahawk Weapons and Tactics Program (SWTP). Additional Qualification Designations (AQDs) are assigned to pilots and billets to further optimize the manpower and personnel processes. Currently, AQDs do not perfectly reflect the tactical qualifications defined in the SWTP.

Naval helicopter aviation is organized into communities that fall under the authority of wings. The Helicopter Sea Combat (HSC) wing is constructed of two sub-communities. Eventually, all HSC carrier-force and expeditionary squadrons will fly the MH-60S. The only anomaly is HSC-84 and HSC-85 who operate the HH-60H in support of dedicated special operations forces. Attainment of qualification for the HSC-84/85

mission sets requires those standards set forth by all other HSC squadrons and an additional tactical qualification syllabus. Gaining this level of qualification warrants the DWE AQD and is a billet requirement for HSC-84.

A literature review reveals a direct correlation between skilled labor and performance. In addition, investment in human capital is the single most important endeavor for organizations attempting to maintain a competitive edge. A look into the definition of careers and the concept of "boundaryless careers" yields some of the challenges associated with deviation from a preferred career path. Finally, the need for SOF aviation expansion is evident. HSC-84/85 assist in filling the gap, but much emphasis is placed on developing increased skill levels in order to meet the challenges of operating in the special operations environment.

III. DATA AND METHODOLOGY

A. INTRODUCTION

This thesis employs quantitative and qualitative approaches to provide evidence in support of addressing the primary and secondary research questions. The first approach involves devising a simulated training syllabus to acquire tactical qualifications and to estimate total training expenses based on helicopter operating costs. Helicopter pilot data are interpreted using Markov Models to determine transition probabilities. In addition, a fixed-inventory model generates recruitment targets based on future helicopter pilot requirements. Current squadrons' Activity Manpower Documents (AMDs) evaluate requirements and billets authorized among different types of Helicopter Sea Combat (HSC) squadrons. Lastly, aggregate pilot requirements determine community demand by means of a suggested sea/shore rotation cycle.

B. DATA SOURCES

1. Defense Manpower Data Center

Panel data were provided by the Defense Manpower Data Center (DMDC) on Navy helicopter pilots from 1995 to 2013. The data include the officer's rank, current assignment, years of service, file date, and a random, unique identification code. Each snapshot was taken on September 30 and resulted in a total of 49,197 observations. AQDs were requested as well, but DMDC only has these data starting in 2013. Rank is given as pay grade and ranged from O-1 (Ensign) to O-6 (Captain). Current assignment was designated by Unique Identification Code (UIC). There were 1,471 unique UICs, of which 349 could not be found, however, these UICs only accounted for 5,106 observations. Each of the known UICs was identified as a flying billet or non-flying billet. The final result illustrates a specific helicopter pilot, their rank, and whether or not they were operating in a flying status for a particular year.

2. Activity Manpower Document

The current AMDs for HSC-84, HSC-26 and HSC-9 were retrieved from Navy Manpower Analysis Center (NAVMAC) via the Total Force Manpower Management System (TFMMS). The documents contain each squadron's requirements and distinguish them by billet identification, rank, Navy Officer Billet Classification (NOBC) code, AQDs, and Manpower Resource Code (MRC). Codes and definitions relating to aviator requirements for the AMDs are located in Appendix A.

C. FLIGHT HOUR COST

The Navy Flight Hour Program (FHP) determines which portion of the Operation & Maintenance, Navy (O&M, N) appropriation fund is to be utilized for air operations. The specific allocation for squadrons is determined by their respective Type Commander and is based on readiness level and historic squadron flight hour cost reports (Sarisen, 2007). Cost per flight hour (CPH) is delineated by the type/model/series (T/M/S) aircraft and comprises the maintenance and fuel costs, among other things, associated with operating the aircraft for one hour. CPH values vary by squadron location (East / West coast) and deployment status. Fiscal year 2013 flight hour costs for the MH-60S and HH-60H were acquired from HSC Wing Atlantic Current Readiness Analyst (N44A/N81C), responsible for tracking aircraft expenditures and are detailed in Table 4 (personal communication, February 21, 2014).

A/C	Deployment Status	CPH
MH-60S	Carrier Force	$2,672.44
MH-60S	Expeditionary	$3,007.20
HH-60H	Expeditionary - Reserves	$5,339.30

Table 4. FY-13 HSC Atlantic Cost Per Flight Hour

For comparison purposes, two different training syllabi are constructed utilizing the HSC Seahawk Weapons and Tactics Program (2012). Each syllabus details the number of flights required to attain a particular qualification. The flight cards prescribe

minimum flight hours required for completion. From here, a total cost estimate is calculated.

D. MARKOV MODELS

The panel data from DMDC were merged utilizing Statistical Analysis System (SAS) software in order to calculate flows to and from pre-established states. These states are defined by rank and assignment, either flying or not flying. Transition probabilities are calculated with the formula in Equation (1). From the equation, the estimated probability ($\hat{p}_{ij}$) an individual transitions from state i to state j is the result of dividing the aggregate flows between those states (f_{ij}) by the summation of observations that started out in state i (n_i) at time t for T time-steps.

$$\hat{p}_{ij} = \frac{\sum_{t=1}^{T} f_{ij}(t)}{\sum_{t=1}^{T} n_i(t)} \quad (1)$$

Figure 4 depicts a graphical representation of the model.

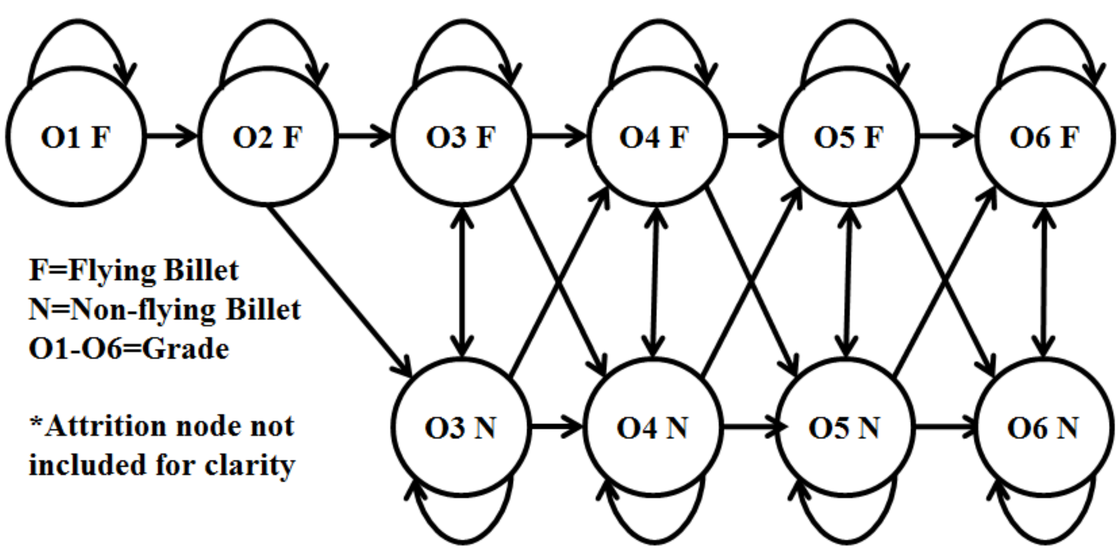

Figure 4. Transition States for Navy Helicopter Pilots

1. Average Time Spent in Flying / Non-Flying Tours

Under the assumption that demotion is not possible, the model depicts the probability an officer will make it to a certain state, given they currently reside in a particular state. As Figure 4 illustrates, an O-3 pilot assigned to a billet requiring flying in a particular year can move to one of five states in the next year. They can remain in their current assignment. They can change assignments to one not involving flying, but remain the same rank. They can be promoted to O-4 and be assigned to either a flying billet or non-flying billet. Finally, they can attrite, which is not shown for clarification purposes. All states can transition to the attrition absorption state. Analysis of the fundamental matrix reveals the expected time an individual spends in a specific state, given they started in a specific state. Through analyzing these values, career progression can be estimated by determining average time spent in flying billets and probability that certain ranks are achieved. Equation (2) for the fundamental matrix ($\mathbf{S}$) is derived from taking the inverse of the difference in the identity matrix ($\mathbf{I}$) and the transition matrix ($\mathbf{P}$).

$$\mathbf{S} = (\mathbf{I} - \mathbf{P_T})^{-1} \tag{2}$$

2. Fixed Inventory

In a brief provided by PERS-43, Division Director of Aviation Assignments, Navy Personnel Command (NPC) (2013, slide 5), rotary-wing (RW) aviation is a growing community. At the time of the brief, there were 7,253 naval aviators in the fleet. Helicopter pilots comprised 3,227, or 44% of all the pilots in the Navy. The goal of NPC is to grow the amount of helicopter pilots to represent 50% of all naval aviators by 2017 (PERS-43, 2013, slide 5).

Accession required to achieve this goal can be determined by means of a fixed-inventory manpower model. The model's distribution of accessions ($\mathbf{r}$) is determined from the data set, as is the initial inventory distribution ($\mathbf{n}(0)$). A key assumption is that the target inventory will be achieved each year until 2017 and will represent 50% of the current population of aviators. Without specific knowledge on the target inventory of all aviators or the future of fiscal budgets, the current population represents the most

accurate forecast of requirements. The model serves as the framework for determining any target inventory with any accession distribution values. The model is derived from the Equation (3) where $\mathbf{n}(t)$ represents the distribution vector of the inventory at time t and $\mathbf{n}(t-1)$ is the previous time-steps inventory distribution vector. The symbol $\mathbf{P}$ is the transition probability matrix, R is the target recruitment, and $\mathbf{r}$ is the distribution vector of accessions.

$$\mathbf{n}(t) = \mathbf{n}(t-1) * \mathbf{P} + R * \mathbf{r} \tag{3}$$

3. Stationarity

Before 1999, the pilot flow data were deemed insufficient and not included. Transition matrices were constructed for each year subsequent through 2013. Aggregate models were formulated utilizing different sets of annual transition probabilities. The first model includes years 2000-2013 and is succeeded by models that use fewer years than the preceding one (i.e., 2002-2013, 2004-2013, etc.). Standard errors and confidence intervals are calculated for each annual transition probability matrix. The aggregate transition probability matrix for each model is analyzed to determine how values fall within the confidence intervals for the years included in that particular model. The number of years included in the model and the cumulative number of transition estimation that are possible determine the maximum value of transition probabilities the model can accurately approximate. The proportion of positive validations from the aggregate transition matrix to the value of estimations possible provides a stationary assessment of the model. An example of this process is exhibited in Appendix B. Confidence interval evaluation figures for all models tested are displayed in Table 5.

Model (FY)	Confidence Level (%)
00-13	47%
02-13	47%
04-13	48%
06-13	54%
08-13	59%
10-13	53%
12-13	56%
13	100%

Table 5. Stationary Evaluation

4. Cross Validation

Only the year 2013 model proved stationary, which is expected since the aggregate transition probabilities only include that year's transition probabilities. The same outcome would occur if any year was looked at individually. Therefore, cross-validation was conducted to determine how well the one-year models describe their actual inventory totals collected from the data. The cross-validation examines how close each annual model's transition probabilities illustrate the inventory at the end of their year. A graphical representation of these results is presented in Figure 5.

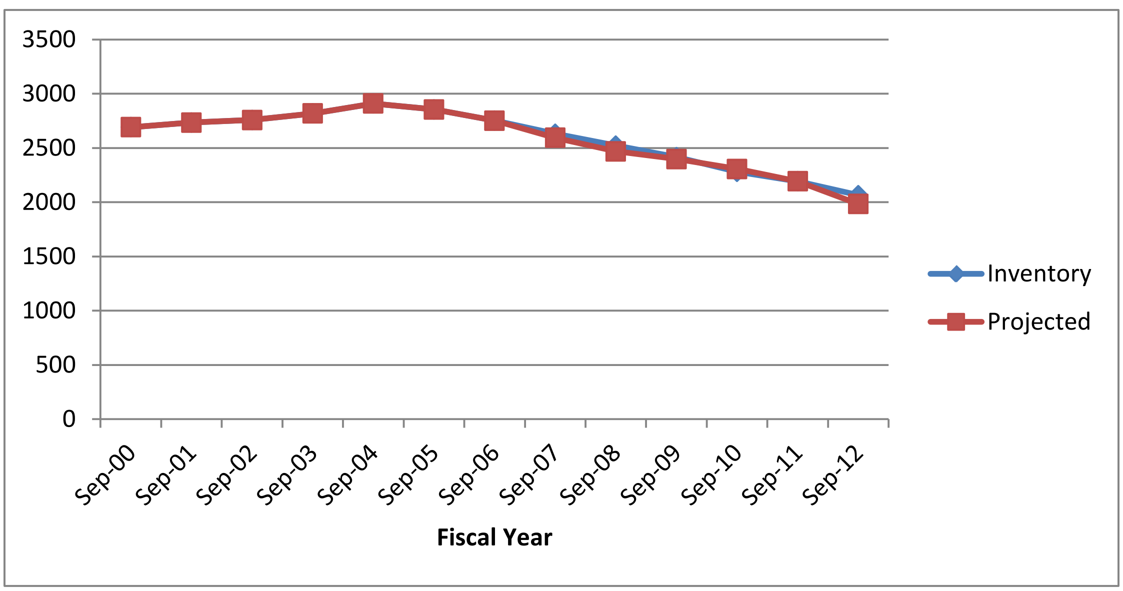

Figure 5. Model Cross-Validation

E. MANPOWER AND PERSONNEL ESTIMATES

a. Sea / Shore Rotation Requirements

The AMD provides funded requirements, by rank, for HSC squadrons. Despite timing and budget constraints, the AMD assumes all squadrons are manned to the optimal level. Therefore, based on the number of squadrons and the different constructs of the three types of HSC squadrons (Carrier Force, Expeditionary, and HSC-84/85), the total requirements for helicopter pilots can be calculated and distinguished by rank. These values provide an itemization of the HSC force. The Naval Military Personnel Manual, Article 1301-110 (CNP, 2004) prescribes aviation officer tour lengths and the appropriate sea/shore rotation requirements. Although these mandates contain some variability based on milestone achievement and community, they can be used to determine the total force funded. For example, every O-4 helicopter pilot required to fill an at sea department head billet, another is required ashore on a staff waiting to fill that billet. This sea/shore rotation cycle increases the number of pilots at any given rank required to properly man the community.

F. CHAPTER SUMMARY

Two simulated training pipelines are modeled after the SWTP. Fight hour costs are applied in order to estimate the investment value on qualifying helicopter pilots. Panel data from DMDC provide historical information on the career progression of helicopter pilots. This study formulates Markov Models from the data, and uses them to determine expected time spent in any given state, given certain assumptions. They also assist in forecasting recruitment requirements to attain a target inventory.

The second data set comes from current AMDs for various HSC squadrons. The requirements are distinguished by rank, NOBC codes, and AQDs. Applying those numbers to the Navy's authorized sea/shore rotation cycle for aviators, a total force funded requirement is determined for the entire HSC community.

Many assumptions are made in the processing of the data and development of the models. Pending more accurate data, all models can be adjusted to meet the requirements of the user. They provide the framework and processes to determine community health and analyze career progression.

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IV. RESULTS

A. INTRODUCTION

A cost analysis details tactical flight training estimates for three different types of helicopter sea combat (HSC) squadrons. Transition probabilities derive expected time spent in a particular pay grade and flying status. The model also assists in determining future recruitment requirements in order to achieve a target fixed inventory. Lastly, total billets authorized are calculated based on rank and a prescribed sea/shore rotation cycle.

B. TOTAL TRAINING COST

Differentiating the total costs to train pilots to specific qualification levels assists in determining the optimal timing of assignments. HSC-84 and HSC-85 have higher training cost due to the HH-60H's larger cost per flight hour (CPH) value. Training costs are approximately $200,000 more to qualify a pilot in the ASUW/PR/SOF Level III syllabus than other HSC squadrons. The cost estimates also suggest the burden to train a pilot in the TAC Level III syllabus is relatively similar to other HSC squadrons training in the ASUW/PR/SOF primary mission areas (PMA). Applying comparable length of tours at all squadrons indicates the inefficiencies of elongating the training syllabus given the time to train.

1. Seahawk Weapons and Tactics Program Syllabus

Based on SWTP flight training requirements, two pipelines are examined. The first syllabus results in attainment of ASUW/PR/SOF Level III qualification at an HSC squadron other than HSC-84/85. This status is actually the result of achieving three separate level qualifications in each of the primary mission areas (PMA) and completion of the fundamental flight training syllabus. The second program accounts for acquiring ASUW/PR/SOF Level III at HSC-84/85 as well as the TAC Level III qualification. Table 6 illustrates total number of flight events and minimum flight hours mandated for designation.

PMA Syllabus	HSC Squadron (other than HSC-84/85)		HSC-84/85	
	Events	Minimum Flight Hours	Events	Minimum Flight Hours
Fundamental	16	17	16	17
ASUW Level III	8	12	8	12
PR Level III	12	24	10	22
SOF Level III	19	32	16	32
TAC Level III	N/A	N/A	28	42
Total	55	85	78	125

Table 6. Training Requirements

2. Cost Estimates

Total cost estimates are calculated by applying the CPH to the minimum prescribed flight hours to complete a syllabus. The result is the investment required to train one pilot to a specific qualification at a specific type of HSC squadrons. As mentioned earlier, HSC-84 and HSC-85 represent the entire HSC expeditionary reserve force and operate the HH-60H aircraft. Two key points are made from the cost estimates in their application to a closed-loop versus a preferred career path. First, HSC-84/85's TAC Level III syllabus requires a substantial amount of flights. If the ASUW/PR/SOF Level III syllabus needs to be completed prior to beginning the TAC Level III syllabus, the time to train will consume most of a pilot's tour at a squadron. A very small return on investment is realized due to the limited time the pilot can fulfill the operational mission capability. The second issue is the additional large investment required to attain TAC Level III designation. If all pilots are assumed to come to HSC-84/85 as an ASUW/PR/SOF Level III, then the total cost to attain TAC Level III is the same. But, if a pilot first comes to HSC-84/85 as a department head, then the time taken away from the increased responsibilities of that billet imply that the individual would be less effective at being an asset to the squadron. Closed-loop detailing requires pilots to come to HSC-84/85 as a department head only if they have attained the TAC Level III qualification. The preferred career path discourages subsequent tours at the same squadron. Under that model, it is difficult to take advantage of the full investment required to attain tactical

qualifications. Utilizing fiscal year 2013 CPH data for Atlantic Fleet squadrons, aggregate values are presented in Table 7.

Syllabus	Aircraft / Deployment Status	Total Cost
Fund/ASUW/PR/SOF Level III	MH-60S (Carrier Force)	$227,157.40
Fund/ASUW/PR/SOF Level III	MH-60S (Expeditionary)	$255,612.18
Fund/ASUW/PR/SOF Level III	HH-60H (Expeditionary - Reserves)	$443,161.90
TAC Level III	HH-60H (Expeditionary - Reserves)	$224,250.60

Table 7. Total Training Costs Per Pilot

C. EXPECTED TIME SPENT IN GRADE

Appendix C contains Markov Models derived from DMDC data collected. Through interpretation of the fundamental matrix, the expected time a pilot spends in a specific rank and how many of those years are spent flying is produced and exhibited in Table 8. The results validate current career milestones for promotion. In addition, the expected values illustrate that approximately half of a helicopter pilot's career is spent in a flying billet at any given rank. This concept conveys the notion that the HSC community places a high value on assignments that involve the aviation warfare specialty.

Rank	Time in Service	Years Spent Flying
O-1	2.0	1.0
O-2	4.4	2.0
O-3	10.6	4.9
O-4	16.6	7.6
O-5	25.7	12.9

Table 8. Expected Time in Service/Flying

D. FIXED-INVENTORY

Rotary-wing (RW) pilots currently represent 44% of the current naval aviator inventory. In order to increase this proportion to 50% by FY2017, the force must grow by 400 RW pilots in four years. Based on a stationary FY2013 transition model and historical accession distribution data, annual recruitment goals required to achieve inventory targets is calculated. The results represent recruitment by designation as a naval rotary-wing pilot and entry into the fleet. On average, 181 RW pilots enter the inventory and 236 attrite. In order to reach the target inventory of 3,627 pilots, annual accessions need to grow by approximately 490 helicopter pilots. This goal compensates for an increase in attritions to 380 and the 100 pilots that need to be added to the inventory each year. The annual RW accession goals are displayed in Table 9. The complete fixed-inventory model is located in Appendix C.

Fiscal Year	Recruitment Target
2014	481
2015	484
2016	494
2017	508

Table 9. Annual RW Pilot Accession Target

E. HSC COMMUNITY MANPOWER REQUIREMENTS

1. Activity Manpower Document Distribution

Examinations of current Activity Manpower Documents (AMD) for three types of HSC squadrons yield requirements and billets authorized for officers. The HSC-9 AMD represents carrier force squadrons. The HSC-26 AMD defines manpower signals for expeditionary squadrons. Expeditionary reserve squadrons are signified by HSC-84's AMD distribution. Tables 10, 11, and 12 specify this distribution by rank, designator, resourcing (i.e., active duty, reserve), and Additional Qualification Designation (AQD). Table 13 provides aggregate values for all squadrons encompassing the HSC community.

HSC-9 AMD	Requirements			Billets Authorized			
Grade	Officers	Pilots	Active Duty Pilots	Officers	Pilots	Active Duty Pilots	Active Duty DWE AQD
W-1 thru W-5	3	0	0	2	0	0	0
O-1	1	0	0	1	0	0	0
O-2	18	16	16	14	12	12	0
O-3	11	10	10	11	10	10	0
O-4	6	5	5	6	5	5	0
O-5	2	2	2	2	2	2	0
Total	41	33	33	36	29	29	0

Table 10. HSC-9 AMD Requirements and Billets Authorized

HSC-26 AMD	Requirements			Billets Authorized			
Grade	Officers	Pilots	Active Duty Pilots	Officers	Pilots	Active Duty Pilots	Active Duty DWE AQD
W-1 thru W-5	1	0	0	1	0	0	0
O-1	1	0	0	3	2	2	0
O-2	45	41	41	36	33	33	0
O-3	22	19	19	21	18	18	0
O-4	9	7	7	9	7	7	0
O-5	2	2	2	2	2	2	0
Total	80	69	69	72	62	62	0

Table 11. HSC-26 AMD Requirements and Billets Authorized

HSC-84 AMD	Requirements			Billets Authorized			
Grade	Officers	Pilots	Active Duty Pilots	Officers	Pilots	Active Duty Pilots	Active Duty DWE AQD
W-1 thru W-5	1	0	0	1	0	0	0
O-1	4	0	0	4	0	0	0
O-2	31	30	13	24	23	13	0
O-3	15	12	5	13	10	5	4
O-4	7	6	3	12	11	2	2
O-5	4	4	0	8	8	1	1
Total	62	52	21	62	52	21	7

Table 12. HSC-84 AMD Requirements and Billets Authorized

HSC Community	Requirements			Billets Authorized			
Grade	Officers	Pilots	Active Duty Pilots	Officers	Pilots	Active Duty Pilots	Active Duty DWE AQD
W-1 thru W-5	38	0	0	28	0	0	0
O-1	24	0	0	36	12	12	0
O-2	512	466	432	404	364	344	0
O-3	272	238	224	262	228	218	8
O-4	128	104	98	138	114	96	4
O-5	40	40	32	48	48	34	2
Total	1014	848	786	916	766	704	14

Table 13. HSC Community Requirements and Billets Authorized

2. Sea / Shore Rotation Requirements

Sea/shore rotation cycle increases pilot demand in order to ensure optimal manpower needs for assignments other than operational fleet squadrons. Prescribed sea tour length and recommended shore tour lengths, based on current pilot inventory, determine the percentage increase in requirements. The results specify the total active duty requirement for the HSC community. It further delineates those billets demanding the DWE AQD. The results focus on pilot ranks of O-3 through O-5. Traditionally, pilots graduate flight school as O-2s and are promoted early in their first tour. For O-3s, the tour lengths are in reference to their first sea and first shore tour. O-4’s 30/24 month sea/shore

rotation cycle represents their department head tour (third sea tour) and second shore tour. Lastly, O-5 cycles are based on their fourth sea tour and third shore tour. The fourth sea tour may coincide with assignment at a commanding officer. Flight training and the second sea tour are disregarded. These assignments typically result in promotion and/or attrition. Results in Table 14 demonstrate a relatively small DWE requirement for the community.

Rank	O-3	O-4	O-5
Prescribed Sea Tour Lengths	36	30	36
% Total Sea / Shore Tour Length	50%	56%	50%
Recommended Shore Tour Lengths	36	24	36
% Total Sea / Shore Tour Length	50%	44%	50%
AD Pilot Requirement	436	172.8	68
AD DWE Pilot Requirement	16	7.2	4
% DWE Requirement	3.67%	4.17%	5.88%

Table 14. Sea/Shore Rotation Requirements

F. CHAPTER SUMMARY

The data and documents gathered for this study produce a variety of results. The cost differential between training a pilot to the qualification of ASUW/PR/SOF Level III is approximately $200,000 more for HSC-84/85 than other HSC squadrons. The TAC Level III syllabus results in comparable cost estimates to those required for ASUW/PR/SOF Level III at squadrons other than HSC-84/85. The models produce expected time in rank and spent flying similar to current career progression milestones. The expected time for promotion to O-4 is nearly 10 years while O-5 promotion is expected around 17 years. Through the rank of O-5, nearly half of the expected time in rank is served in a flying billet. The models also predict RW recruitment targets in order to grow the community to 50% of the current aviator inventory. Roughly 490 more pilots need to be added each year to all helicopter squadrons in order to reach the goal by 2017. The final set of results illustrates collective requirements and billets for the HSC community by rank. The O-3 through O-5 active component funded for the DWE AQD is 4% of all requirements in the HSC community.

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V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

The Helicopter Sea Combat (HSC) community has a direct requirement to support the special operations forces (SOF) mission. Though small, this requirement entails extensive and costly training pipelines. These assignments serve as a deviation from the normal career path and present two issues. The first issue is distribution. Due to a small number of properly qualified pilots, it is difficult to ensure the requirement can be filled in accordance with current career milestone guidance. The second issue is recognizing the value added when those pilots come before the selection boards. Selection boards have recognized other highly competitive and beneficial assignments to achieve career milestones. Traditionally, less importance has been placed on attaining tactical qualifications since the majority of the HSC community does not recognize the mission requirement.

Managing human capital in the Navy is a tedious process. Balancing investments that provide well-rounded leaders versus those that increase warfighter skills is based on community values and mission requirements. Rotary-wing aviation, like many other warfare specialties, demands a high level of skill attained through training and experience. However, it still requires that officers acquire skills outside of the aircraft. Due to the emphasis placed on creating leaders that possess both skills, the Navy is in a constant struggle at determining how to apply its resources to leadership development. Career progression is the most important aspect of managing these investments.

Closed-loop detailing does not offer the absolute solution for the HSC community in managing its manpower and personnel. Although, there are features of the model that could assist the current detailing processes in optimally managing its requirements and inventory. Placing a greater emphasis on analyzing a pilots potential by their ability to perform missions can increase the community's mission capability and still meet leadership goals.

B. CONCLUSIONS AND RECOMMENDATIONS

How do the costs and benefits of a closed-loop career path compare to those of a diversified pipeline?

a. Conclusion

A pilot that follows the established career path is more likely to promote. Experience gained by completing the first two fleet squadron tours at an HSC squadron other than HSC-84/85 increases the ability to operate as a commanding officer of the same type of squadron. However, if HSC-84/85's funded requirements for active duty pilots are to be allocated, then there will be instances where a pilot must diverge from operating at the types of HSC squadron they served at during their first sea tour. HSC-84/85 assignments should have a negligible effect on selection to O-5. Based on performance, a pilot should remain just as competitive as if they served their department head tour at another HSC squadron. Training costs for the ASUW/PR/SOF Level III syllabus are substantially higher at HSC-84/85. The additional requirement to attain the TAC Level III qualification increases the length of the training pipeline and adds to these costs. These qualifications are most effective if gained on a junior officer tour. Pilots who serve at HSC-84/85 on a previous tour and gain the prescribed TAC Level III qualification can make a much larger contribution to the those squadrons due to the abbreviated training syllabus. The problem lies with denying other HSC squadrons adequately qualified pilots.

b. Recommendation

PERS-43 should ensure HSC-84/85 first time pilots are detailed during their junior officer first shore tour or second sea tour. A closed-loop career path would require at least one of these tours be served at HSC-84/85 in order to be eligible for department head at one of the squadrons.

Who are the stakeholders and what are their primary concerns with both detailing models?

c. Conclusion

Stakeholders are distinguished by those concerned with community health and those concerned with mission effectiveness. The HSC community as a whole maintains some degree of responsibility in both objectives. Those primarily concerned with community health are community managers on a strategic level and Navy Personnel Command on more of a tactical level. Managing end strength and promoting the values of the community are just some of the matters that construct their mission goals. The Navy Manpower Analysis Center, commanding officers, and pilots may find themselves with a larger stake in meeting mission requirements and execution. The stakeholder overlap occurs in making sure the officer inventory possesses a certain level of quality distributed across milestone assignments.

The current detailing model is more effective at imparting community values and producing more well-rounded leaders. Yet, the current process inhibits the development of tactical skill and experience as a warfighter. The hesitation to allow for certain pilots to cultivate their ability to perform more demanding missions depletes the entire community of highly valued human capital. Gauging whether a tour provides diversity, increased skilled level, or both is important in determining what type of career path produces the type of leaders they want. If the focus is on creating commanders with a high degree of squadron experience as well as performance in their warfare specialty, competitive flying billets should be held in high regard.

d. Recommendation

Aviation selection boards should be divided into separate boards for each community in that warfare specialty. Furthermore, the board should establish metrics that take into account tactical qualifications by formally identifying these skill sets through reformed AQDs that match current SWTP level designations in each of the primary mission areas. Aviation community managers should observe assignment at HSC-84/85

as a competitive flying billet equal to value added at tours such as production squadrons or weapons schools.

What is the impact of increasing the naval aviator inventory to 50% rotary-wing pilots?

e. Conclusion

There are two possible methods to realizing this target inventory. The first is to maintain current recruitment goals for rotary-wing pilots while reducing the inventory of all other aviation communities. The second method calls for a considerable increase in the inventory of helicopter pilots. The magnitude of this growth is contingent on the status of funded requirements for naval aviators. If the latter holds true, these requirements must come from an increase in the manning of squadrons or the creation of additional squadrons based on a redeveloped set of mission priorities for the community. Shore billet requirements must also be increased to compensate for redeveloped sea/shore rotation cycles. Aviation special operations forces have produced a demand signal for mission capable assets. Maintaining or increasing funded requirements to HSC-84 and HSC-85 for appropriately qualified pilots assist in meeting these needs.

There is a concern over the distribution of qualified pilots to HSC squadrons which provides insight into a greater issue. Currently, there is no demand signal for any tactical qualification level at HSC squadrons other than HSC-84/85. Without a funded requirement, there is no formal incentive to ensure pilots gain these qualifications during their first sea tour. In addition, HSC pilot inventory cannot be adequately managed to compensate for the growing mission requirements.

f. Recommendation

Air Warfare Resource Sponsor (N98) requests Navy Manpower Analysis Center generate HSC squadron requirements to dictate the attainment of applicable tactical qualifications for department heads. Budget Submitting Offices and the Air Warfare Resource Sponsor should fund more of these requirements to generate more adequately qualified helicopter pilots. Community managers should prioritize their values to

generate a larger inventory that is tactically qualified to fulfill the shift in mission requirements.

C. FURTHER RECOMMENDED RESEARCH

1. Additional Qualification Designation Data

The Defense Manpower Data Center (DMDC) was unable to retrieve accurate data on helicopter pilot Additional Qualification Designations (AQD). Future research may be able to develop inventory models on the proportions of the HSC community that attains these qualifications and when they are achieved during a pilot's career. The result would create a more precise depiction of career paths as well as illustrate a possible need for a demand signal. The data set also posed inventory values that differ from current Navy Personnel Command figures. Collecting data via other resources such as the Bureau of Naval Personnel might provide a more comprehensive sample of the population.

2. Reserve Component

An important aspect of this research that was neglected is the effect of attrition from the active component of the HSC community to the reserves. Pilots who have attained qualification at HSC-84/85 and may not be detailed back there may choose to transfer to the reserves in order to continue performing those missions. This departure may deplete the pool of qualified pilots for the HSC community more quickly than if they were closed-loop. Due to the nature of HSC-84/85 being a reserve squadron with an active duty augment, the scope of this thesis only addresses a small portion of what is required to maintain their mission capability. Full time support and selected reserve personnel provide a more beneficial dynamic in supporting the SOF mission. Due to the limited number of potential flying assignments, those pilots remain in that mission set for much longer periods of time. Using the reserve processes for manpower and personnel, the size and scope of the active duty augment can be examined.

3. Promotion

Due to the lack of variables gathered from the data set, this research did not address to what extent, certain factors affect promotion. Acquiring detailed information

on specific assignments and categorizing them, a better model for determining the preferred career path may be developed. Discussion with PERS-43 on how their statistical analysis of selection board results is performed can provide the framework for enhancing these predictors.

APPENDIX A. ACTIVITY MANPOWER DOCUMENT CODES AND DEFINITIONS

Tables 15 through 21 are from OPNAVINST 1000.16K (CNO, 2007), NAVPERS 15838I (CNP, 2014), and NAVPERS 16000A (NAVMAC, 2003).

Billet Identification Number (BIN)	7-digit number generated by TFMMS / TFARS when a manpower requirement, organizational header, or billet note is initially entered into the system. Since TFMMS / TFARS assigns the BIN to a new manpower requirement, BINs cannot be duplicated for changed.
Billet Title	A field, consisting of up to 40 characters, used for the manpower requirement title, organization header, or billet note information. The following applies: Begin the title for officer manpower requirements with the NOBC short title. Additional title information or remarks can be made after a "/."
Manpower Resource Codes (MRC)	Code identifies the types of resourcing (MPN, RPN or OM&N) for the manpower requirement.
Officer Designators Codes	Identifies specialty qualification
Rank Codes	Paygrade necessary to fill a particular manpower requirement.
Navy Officer Billet Classification (NOBC) Codes	Identifies officer billet requirements and officer occupational experience acquired through billet experience or through a combination of education and experience.
Additional Qualification Designation (AQD) Codes	Identifies the additional qualifications required by the MFTs not included in other classifications. Though AQDs are listed against the manpower authorization on the AMD/AWD, the primary AQD is added, changed, or deleted on the manpower requirement side of TFMMS / TFARS, and secondary AQD is added, changed, or deleted on the manpower authorization side of TFMMS/TFARS.

Table 15. AMD Codes and Definitions (after CNO, 2007)

MRC	Description	Appropriation Category
AD	Active Duty	MPN
RT	Training & Administration of Reserves (TAR) [Full Time Support (FTS)]	RPN (Active)
RA	Selected Reserve	RPN (Inactive)

Table 16. Manpower Resource Codes (after NAVMAC, 2003)

Billet Code	Billet Description	Officer Code	Officer Description	Officer Community Manager (OCM)
*1300	Unrestricted Line Officer billet, Code 0 - Other Than Operational Flying, requiring Air Warfare specialty of, or previous designation as, a pilot or NFO (LT and above)	130X	An Unrestricted Line Officer who is a member of the aeronautical community and whose rating as a pilot or NFO has been terminated. (These officers may be assigned to 1000, 1050, 1300, 1310 or 1320 designated billets, if otherwise qualified.)	Billets: ACNO (Air Warfare) Officers: CHNAVPERS (PERS-43)
*1301	Unrestricted Line Officer billet, Code 1 - Operational Flying, requiring Air Warfare specialty of a pilot or NFO (LT and above)	N/A	N/A	ACNO (Air Warfare)
*1302	Unrestricted Line Officer billet, Code 2 - Operational Flying, requiring Air Warfare specialty of a pilot or NFO	N/A	N/A	ACNO (Air Warfare)
*1310	Unrestricted Line Officer billet, Code 0 - Other Than Operational Flying, requiring Aviation Warfare specialty of a pilot	131X	An Unrestricted Line Officer who is qualified for duty involving flying heavier-than-air, or heavier and lighter-than-air type of aircraft as a pilot	ACNO (Air Warfare)
*1311	Unrestricted Line Officer billet, Code 1 - Operational Flying, requiring Aviation Warfare specialty of a pilot	NA	N/A	ACNO (Air Warfare)
*1312	Unrestricted Line Officer billet, Code 2 - Operational Flying, requiring Aviation Warfare specialty of a pilot	NA	N/A	ACNO (Air Warfare)

Table 17. Aviation Designator Codes (from CNP, 2014)

Pers Code	Grade	Pay Grade	Abbr.
G	Captain	O6	CAPT
H	Commander	O5	CDR
I	Lieutenant Commander	O4	LCDR
J	Lieutenant	O3	LT
K	Lieutenant (Junior Grade)	O2	LTJG
L	Ensign	O1	ENS
M	Chief Warrant Officer-4	W4	CWO4
N	Chief Warrant Officer-3	W3	CWO3
O	Chief Warrant Officer-2	W2	CWO2
P	Warrant Offficer-1	W1	WO1
R	Chief Warrant Officer-5	W5	CWO5

Table 18. Officer Grade Codes (after CNP, 2014)

NOBC	Billet Title	Requirements
8670	SQUADRON COMMANDING OFFICER	Commands aircraft squadron in carrying out assigned mission. Prepares squadron policies and directives, complying with regulations and instructions from higher commands. Organizes divisions, including aircraft maintenance, aviation ordnance, flight operations, material and training, administrative and supply. Conducts squadron training. Reviews flight proficiency. Ensures operational readiness of aircraft. Investigates delays by maintenance personnel. Operates squadron aircraft.
8672	SQUADRON EXECUTIVE OFFICER	Assists commanding officer in carrying out and administering squadron policies and directives. Prepares squadron bills and orders. Interviews and assigns enlisted personnel. Consults department heads and division officers when planning squadron activities. Establishes daily routine. Directs such administrative activities as maintaining personnel records, reviewing all correspondence, enforcing system for advancement in rating and preparing required reports. Operates squadron on-type aircraft.
8675	SQUADRON DEPARTMENT HEAD	Assists Commanding Officer by exercising leadership of respective squadron department in execution of squadron mission. Types of Squadron Departments include but are not limited to: Operations, Maintenance, Administrative, Safety, Training, and other functional areas deemed departmental equivalents by the Commanding Officer.
8501	AVIATOR	Pilots or Naval Flight Officers responsible for the safe operation of naval aircraft with regards to command, piloting navigation, communications, or weapons system operation management in support of various missions of the Navy.
8653	OFFICER IN CHARGET, AVIATION UNIT OR DETACHMENT	Directs operations of aviation unit or aviation detachment of major activity. Ensures compliance with policies, directives, regulations and instructions received from parent activity or other authority. Supervises training requirements, reviewing proficiency of personnel assigned and instituting training to correct deficiencies. Operates unit aircraft on routine training and operational flights.

Table 19. Navy Officer Billet Classification Codes (from CNP, 2014)

MISSION CLASS	CODE	MISSION/TYPE PILOT/NFO	A/C IDENT	PRIMARY CONSULTANT	CONSULTANTS
Combat Support	DW1 DW4 DW5 DW6 DW7 DW8 DW9 DW0 DWA DWB DWC DWD	Attack/SAR/Logistics SAR/Logistics SAR/Logistics SAR/MCM/Logistics SAR/Logistics SAR/MCM/Logistics CSAR Any Basic/PQM SAR/Logistics Combat/SAR Mine Warfare	A/UH-1 UH-3 C/U/HH-46 RH-53 CH-53 MH-53 HH-60H SAR/Mine Counter-Measures/Logistics MH-60S MH-60S MH-60S MH-60S	OPNAV N98M	BUPERS-31 PERS-4
Transport	DX1	Transport	VH-3	OPNAV N98M	BUPERS-31 PERS-4
Training	DY1 DY2	Instructor (Fleet Experience) Weapons and Tactics Instructor (WTI)	Any Helo H-60	OPNAV N98M	BUPERS-31 PERS-4
Training Pipeline	DY5 DY6	Pilot Training - Helo NFO Training - ASW	Any Helo	OPNAV N98M	BUPERS-31 PERS-4
General (Helo)	DY0 DY3	Any Helo Composite	Any Helo	OPNAV N98M	BUPERS-31 PERS-4

Table 20. Additional Qualification Designation Codes (from CNP, 2014)

CHARACTER					OFFICER AWARDING CRITERIA	BILLET DETAILING PREREQUISITES	CONSULTANTS
1ST	2ND		3RD				
	CODE	TITLE	CODE	TITLE	Officer will be awarded this AQD if member has:	If other than "N/A", then there are existing billet requirements coded in TFMMS.	
D	W	Combat Support	E	Special Warfare	(a) Qualified as Combat Aircraft Commander (TAC Level III); AND (b) Completed at least 24 months (cumulative) in HSC-84 or HSC-85. AND (c) Been recommended by the Commanding Officer of HSC-84/85. NOTE: Officers who served post 2003 in disestablished squadrons HCS-4/5 are also eligible for this AQD with a minimum of one combat deployment of 3-4 months. Designators: 131X, 732X Grades: W2 to O6 Length of validity: Indefinite Manpower type: Active and Reserve	Billets coded with DWE require an officer to have been awarded the DWE code prior to reporting to ultimate duty assignment. NOTES: (1) For LCDR selected for DH, non screened CDR, and XO/CO billets, to the maximum extent possible, these should be officers with DWE prior to reporting to ultimate duty assignment. (2) For CWOs and LCDR and below not selected for DH these officers may be awarded with DWE upon qualification while assigned to designated billets. Designators: 1310, 1311, 1312, 7320 Grades: W2 to O6	Primary: OPNAV N98 Auxiliary: BUPERS-31, PERS-4

Table 21. Additional Qualification Designation Codes (from CNP, 2014)

APPENDIX B. CONFIDENCE EVALUATION EXAMPLE

Appendix B contains example of confidence evaluation for fiscal year (FY) 2012–2013 model. A model with a confidence level exceeding 70% is considered to be stationary. A stationary model demonstrates the assumption that the transition probability between two unique states is constant over time.

Table 22 and Table 23 illustrate the flows from the transient states listed in the left columns to those states listed in the top rows throughout the specified year. The totals column represents the inventory of the transient state at the end of the year. Table 24 is the result of totaling the flows for all the years used to construct the model.

FY12 FLOWS	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite	Totals
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	39	0	76	0	0	0	0	0	0	0	115
O03N	0	0	0	0	103	16	28	4	0	0	0	0	24	175
O03Y	0	0	0	0	84	553	6	29	0	0	0	0	59	731
O04N	0	0	0	0	0	0	114	54	23	5	0	0	24	220
O04Y	0	0	0	0	0	0	76	237	1	9	0	0	22	345
O05N	0	0	0	0	0	0	0	0	188	32	16	1	44	281
O05Y	0	0	0	0	0	0	0	0	30	110	0	2	17	159
O06N	0	0	0	0	0	0	0	0	0	0	89	5	38	132
O06Y	0	0	0	0	0	0	0	0	0	0	8	18	9	35
Attrite	0	0	0	0	24	59	24	22	44	17	38	9	1	

Table 22. FY 2012 Flows

FY13 FLOWS	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite	Totals
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	3	0	0	0	0	0	0	0	0	0	3
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	35	0	78	0	0	0	0	0	0	3	116
O03N	0	0	0	0	118	10	24	7	0	0	0	0	29	188
O03Y	0	0	0	0	92	452	0	26	0	0	0	0	99	669
O04N	0	0	0	0	0	0	124	35	26	10	0	0	30	225
O04Y	0	0	0	0	0	0	73	199	2	15	0	0	37	326
O05N	0	0	0	0	0	0	0	0	180	21	16	0	25	242
O05Y	0	0	0	0	0	0	0	0	41	102	2	4	7	156
O06N	0	0	0	0	0	0	0	0	0	0	94	3	16	113
O06Y	0	0	0	0	0	0	0	0	0	0	6	18	2	26
Attrite	0	0	0	3	29	99	30	37	25	7	16	2	1	

Table 23. FY 2013 Flows

AGGREGATE FLOWS	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite	Totals
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	3	0	0	0	0	0	0	0	0	0	3
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	74	0	154	0	0	0	0	0	0	3	231
O03N	0	0	0	0	221	26	52	11	0	0	0	0	53	363
O03Y	0	0	0	0	176	1005	6	55	0	0	0	0	158	1400
O04N	0	0	0	0	0	0	238	89	49	15	0	0	54	445
O04Y	0	0	0	0	0	0	149	436	3	24	0	0	59	671
O05N	0	0	0	0	0	0	0	0	368	53	32	1	69	523
O05Y	0	0	0	0	0	0	0	0	71	212	2	6	24	315
O06N	0	0	0	0	0	0	0	0	0	0	183	8	54	245
O06Y	0	0	0	0	0	0	0	0	0	0	14	36	11	61

Table 24. Aggregate Flows

Table 25 and Table 26 show the annual transition probabilities between the different states. They are derived from the proportion of flows for a particular transition to the total flows that occurred from the state listed in the left column. Table 27 is the aggregate transition probabilities determined from the aggregate flows table.

FY12 PROBABILITES	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	0	0	0	0	0	0	0	0	0	0
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	0.33913	0	0.66087	0	0	0	0	0	0	0
O03N	0	0	0	0	0.58857	0.09143	0.16	0.02286	0	0	0	0	0.13714
O03Y	0	0	0	0	0.11491	0.7565	0.00821	0.03967	0	0	0	0	0.08071
O04N	0	0	0	0	0	0	0.51818	0.24545	0.10455	0.02273	0	0	0.10909
O04Y	0	0	0	0	0	0	0.22029	0.68696	0.0029	0.02609	0	0	0.06377
O05N	0	0	0	0	0	0	0	0	0.66904	0.11388	0.05694	0.00356	0.15658
O05Y	0	0	0	0	0	0	0	0	0.18868	0.69182	0	0.01258	0.10692
O06N	0	0	0	0	0	0	0	0	0	0	0.67424	0.03788	0.28788
O06Y	0	0	0	0	0	0	0	0	0	0	0.22857	0.51429	0.25714

Table 25. FY 2012 Transition Probabilities

FY13 PROBABILITES	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	1	0	0	0	0	0	0	0	0	0
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	0.30172	0	0.67241	0	0	0	0	0	0	0.02586
O03N	0	0	0	0	0.62766	0.05319	0.12766	0.03723	0	0	0	0	0.15426
O03Y	0	0	0	0	0.13752	0.67564	0	0.03886	0	0	0	0	0.14798
O04N	0	0	0	0	0	0	0.55111	0.15556	0.11556	0.04444	0	0	0.13333
O04Y	0	0	0	0	0	0	0.22393	0.61043	0.00613	0.04601	0	0	0.1135
O05N	0	0	0	0	0	0	0	0	0.7438	0.08678	0.06612	0	0.10331
O05Y	0	0	0	0	0	0	0	0	0.26282	0.65385	0.01282	0.02564	0.04487
O06N	0	0	0	0	0	0	0	0	0	0	0.83186	0.02655	0.14159
O06Y	0	0	0	0	0	0	0	0	0	0	0.23077	0.69231	0.07692

Table 26. FY 2013 Transition Probabilities

AGGREGATE PROBABILITIES	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	1	0	0	0	0	0	0	0	0	0
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	0.32035	0	0.66667	0	0	0	0	0	0	0.01299
O03N	0	0	0	0	0.60882	0.07163	0.14325	0.0303	0	0	0	0	0.14601
O03Y	0	0	0	0	0.12571	0.71786	0.00429	0.03929	0	0	0	0	0.11286
O04N	0	0	0	0	0	0	0.53483	0.2	0.11011	0.03371	0	0	0.12135
O04Y	0	0	0	0	0	0	0.22206	0.64978	0.00447	0.03577	0	0	0.08793
O05N	0	0	0	0	0	0	0	0	0.70363	0.10134	0.06119	0.00191	0.13193
O05Y	0	0	0	0	0	0	0	0	0.2254	0.67302	0.00635	0.01905	0.07619
O06N	0	0	0	0	0	0	0	0	0	0	0.74694	0.03265	0.22041
O06Y	0	0	0	0	0	0	0	0	0	0	0.22951	0.59016	0.18033

Table 27. Aggregate Transition Probabilities

Standard errors are calculated in Table 28 and Table 29 for FY 2012 and FY 2013 using Equation (4).

$$s.e. = \sqrt{\frac{p_{ij} * (1 - p_{ij})}{n_i}} \tag{4}$$

FY12 STANDARD ERRORS	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	0	0	0	0	0	0	0	0	0	0
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	0.04415	0	0.04415	0	0	0	0	0	0	0
O03N	0	0	0	0	0.0372	0.02179	0.02771	0.0113	0	0	0	0	0.026
O03Y	0	0	0	0	0.0118	0.01587	0.00334	0.00722	0	0	0	0	0.01007
O04N	0	0	0	0	0	0	0.03369	0.02901	0.02063	0.01005	0	0	0.02102
O04Y	0	0	0	0	0	0	0.02231	0.02497	0.00289	0.00858	0	0	0.01315
O05N	0	0	0	0	0	0	0	0	0.02807	0.01895	0.01382	0.00355	0.02168
O05Y	0	0	0	0	0	0	0	0	0.03103	0.03662	0	0.00884	0.02451
O06N	0	0	0	0	0	0	0	0	0	0	0.04079	0.01662	0.03941
O06Y	0	0	0	0	0	0	0	0	0	0	0.07098	0.08448	0.07388

Table 28. FY 2012 Standard Errors

FY13 STANDARD ERRORS	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	0	0	0	0	0	0	0	0	0	0
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	0.04262	0	0.04358	0	0	0	0	0	0	0.01474
O03N	0	0	0	0	0.03526	0.01637	0.02434	0.01381	0	0	0	0	0.02634
O03Y	0	0	0	0	0.01332	0.0181	0	0.00747	0	0	0	0	0.01373
O04N	0	0	0	0	0	0	0.03316	0.02416	0.02131	0.01374	0	0	0.02266
O04Y	0	0	0	0	0	0	0.02309	0.02701	0.00432	0.0116	0	0	0.01757
O05N	0	0	0	0	0	0	0	0	0.02806	0.0181	0.01597	0	0.01956
O05Y	0	0	0	0	0	0	0	0	0.03524	0.03809	0.00901	0.01266	0.01658
O06N	0	0	0	0	0	0	0	0	0	0	0.03518	0.01512	0.0328
O06Y	0	0	0	0	0	0	0	0	0	0	0.08263	0.09052	0.05226

Table 29. FY 2013 Standard Errors

Upper and lower confidence limits are displayed in Tables 30, 31, 32, and 33 for their respective FY. They apply the standard error to the transition probability for a particular transition.

FY12 LOWER CONFIDENCE LIMIT	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	0	0	0	0	0	0	0	0	0	0
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	0.29498	0	0.61672	0	0	0	0	0	0	0
O03N	0	0	0	0	0.55137	0.06964	0.13229	0.01156	0	0	0	0	0.11114
O03Y	0	0	0	0	0.10312	0.74062	0.00487	0.03245	0	0	0	0	0.07064
O04N	0	0	0	0	0	0	0.48449	0.21644	0.08392	0.01268	0	0	0.08807
O04Y	0	0	0	0	0	0	0.19798	0.66199	4.2E-06	0.01751	0	0	0.05061
O05N	0	0	0	0	0	0	0	0	0.64097	0.09493	0.04312	6.3E-06	0.1349
O05Y	0	0	0	0	0	0	0	0	0.15765	0.65521	0	0.00374	0.08241
O06N	0	0	0	0	0	0	0	0	0	0	0.63345	0.02126	0.24847
O06Y	0	0	0	0	0	0	0	0	0	0	0.15759	0.4298	0.18327

Table 30. FY 2012 Lower Confidence Limit

FY12 UPPER CONFIDENCE LIMIT	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	0	0	0	0	0	0	0	0	0	0
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	0.38328	0	0.70502	0	0	0	0	0	0	0
O03N	0	0	0	0	0.62577	0.11322	0.18771	0.03415	0	0	0	0	0.1631
O03Y	0	0	0	0	0.12671	0.77237	0.01155	0.04689	0	0	0	0	0.0908
O04N	0	0	0	0	0	0	0.55187	0.27447	0.12517	0.03278	0	0	0.1301
O04Y	0	0	0	0	0	0	0.2426	0.71192	0.00579	0.03467	0	0	0.0769
O05N	0	0	0	0	0	0	0	0	0.69711	0.13283	0.07076	0.00711	0.1783
O05Y	0	0	0	0	0	0	0	0	0.21971	0.72844	0	0.02142	0.1314
O06N	0	0	0	0	0	0	0	0	0	0	0.71503	0.05449	0.3273
O06Y	0	0	0	0	0	0	0	0	0	0	0.29955	0.59877	0.331

Table 31. FY 2012 Upper Confidence Limit

FY13 LOWER CONFIDENCE LIMIT	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	1	0	0	0	0	0	0	0	0	0
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	0.25911	0	0.62884	0	0	0	0	0	0	0.01112
O03N	0	0	0	0	0.5924	0.03682	0.10332	0.02343	0	0	0	0	0.12791
O03Y	0	0	0	0	0.1242	0.65754	0	0.03139	0	0	0	0	0.13425
O04N	0	0	0	0	0	0	0.51795	0.13139	0.09424	0.03071	0	0	0.11067
O04Y	0	0	0	0	0	0	0.20084	0.58342	0.00181	0.03441	0	0	0.09593
O05N	0	0	0	0	0	0	0	0	0.71574	0.06868	0.05014	0	0.08374
O05Y	0	0	0	0	0	0	0	0	0.22758	0.61576	0.00381	0.01299	0.0283
O06N	0	0	0	0	0	0	0	0	0	0	0.79668	0.01143	0.1088
O06Y	0	0	0	0	0	0	0	0	0	0	0.14814	0.60179	0.02466

Table 32. FY 2013 Lower Confidence Limit

FY13 UPPER CONFIDENCE LIMIT	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	1	0	0	0	0	0	0	0	0	0
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	0.34434	0	0.71599	0	0	0	0	0	0	0.0406
O03N	0	0	0	0	0.66292	0.06956	0.152	0.05104	0	0	0	0	0.1806
O03Y	0	0	0	0	0.15083	0.69373	0	0.04634	0	0	0	0	0.1617
O04N	0	0	0	0	0	0	0.58427	0.17972	0.13687	0.05818	0	0	0.156
O04Y	0	0	0	0	0	0	0.24701	0.63744	0.01046	0.05762	0	0	0.1311
O05N	0	0	0	0	0	0	0	0	0.77186	0.10487	0.08209	0	0.1229
O05Y	0	0	0	0	0	0	0	0	0.29806	0.69194	0.02183	0.0383	0.0614
O06N	0	0	0	0	0	0	0	0	0	0	0.86704	0.04167	0.1744
O06Y	0	0	0	0	0	0	0	0	0	0	0.3134	0.78282	0.1292

Table 33. FY 2013 Upper Confidence Limit

Table 34 and Table 35 express whether or not the aggregate transition probability for the model falls within the confidence limits. Table 36 totals all of the annual validations and highlights which of the transition probabilities are possible to estimate.

FY12 AGG PROB WITHIN CONF LIMIT	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	0	0	0	0	0	0	0	0	0	0
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	1	0	1	0	0	0	0	0	0	0
O03N	0	0	0	0	1	1	1	1	0	0	0	0	1
O03Y	0	0	0	0	1	0	0	1	0	0	0	0	0
O04N	0	0	0	0	0	0	1	0	1	0	0	0	1
O04Y	0	0	0	0	0	0	1	0	1	0	0	0	0
O05N	0	0	0	0	0	0	0	0	0	1	1	1	0
O05Y	0	0	0	0	0	0	0	0	0	1	0	1	0
O06N	0	0	0	0	0	0	0	0	0	0	0	1	0
O06Y	0	0	0	0	0	0	0	0	0	0	1	1	0

Table 34. FY 2012 Validation

FY13 AGG PROB WITHIN CONF LIMIT	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	0	0	0	0	0	0	0	0	0	0
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	1	0	1	0	0	0	0	0	0	1
O03N	0	0	0	0	1	0	1	1	0	0	0	0	1
O03Y	0	0	0	0	1	0	0	1	0	0	0	0	0
O04N	0	0	0	0	0	0	1	0	1	1	0	0	1
O04Y	0	0	0	0	0	0	1	0	1	1	0	0	0
O05N	0	0	0	0	0	0	0	0	0	1	1	0	0
O05Y	0	0	0	0	0	0	0	0	0	1	1	1	0
O06N	0	0	0	0	0	0	0	0	0	0	0	1	0
O06Y	0	0	0	0	0	0	0	0	0	0	1	0	0

Table 35. FY 2013 Validation

TOTAL AGG PROB WITHIN CONF LIMIT	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	0	0	0	0	0	0	0	0	0	0
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	2	0	2	0	0	0	0	0	0	1
O03N	0	0	0	0	2	1	2	2	0	0	0	0	2
O03Y	0	0	0	0	2	0	0	2	0	0	0	0	0
O04N	0	0	0	0	0	0	2	0	2	1	0	0	2
O04Y	0	0	0	0	0	0	2	0	2	1	0	0	0
O05N	0	0	0	0	0	0	0	0	0	2	2	1	0
O05Y	0	0	0	0	0	0	0	0	0	2	1	2	0
O06N	0	0	0	0	0	0	0	0	0	0	0	2	0
O06Y	0	0	0	0	0	0	0	0	0	0	2	1	0

Table 36. Model Validation

Table 37 displays the confidence level of the model. With 45 positive validations and 80 possible estimations, this particular model's confidence interval evaluation is 56%, which infers it is not stationary.

Years	2
Possible Estimations	40
Total Possible Estimations	80
Positive Validations	45
Confidence Interval Evaluation	56%

Table 37. Model Confidence Level

APPENDIX C. MARKOV MODELS

Table 38 illustrates the expected probability a pilot transitions from a state listed on the left column to a state listed on the top row. Table 39 displays the expected years an individual spends in a state on the top row given they either achieved or started in a state on the left column. Table 40 represents the target distribution and total number of pilots by rank and flying assignment until fiscal year 2017. Table 41 depicts the distribution of accessions by state that were used to determine the target inventory and are based on historical data.

State	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite
O01N	0	0	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	0	0	1	0	0	0	0	0	0	0	0	0
O02N	0	0	0	0	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	0.30172	0	0.67241	0	0	0	0	0	0	0.02586
O03N	0	0	0	0	0.62766	0.05319	0.12766	0.03723	0	0	0	0	0.15426
O03Y	0	0	0	0	0.13752	0.67564	0	0.03886	0	0	0	0	0.14798
O04N	0	0	0	0	0	0	0.55111	0.15556	0.11556	0.04444	0	0	0.13333
O04Y	0	0	0	0	0	0	0.22393	0.61043	0.00613	0.04601	0	0	0.1135
O05N	0	0	0	0	0	0	0	0	0.7438	0.08678	0.06612	0	0.10331
O05Y	0	0	0	0	0	0	0	0	0.26282	0.65385	0.01282	0.02564	0.04487
O06N	0	0	0	0	0	0	0	0	0	0	0.83186	0.02655	0.14159
O06Y	0	0	0	0	0	0	0	0	0	0	0.23077	0.69231	0.07692
Attrite	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 38. Transition Matrix (P)

State	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y
O01N	1	0	0	0	0	0	0	0	0	0	0	0
O01Y	0	1	0	1.4321	1.16716	3.16017	0.68037	0.69849	0.68449	0.35179	0.38137	0.06222
O02N	0	0	1	0	0	0	0	0	0	0	0	0
O02Y	0	0	0	1.4321	1.16716	3.16017	0.68037	0.69849	0.68449	0.35179	0.38137	0.06222
O03N	0	0	0	0	2.85886	0.46882	1.21461	0.805	1.12658	0.54538	0.62042	0.09898
O03Y	0	0	0	0	1.21205	3.28171	0.70653	0.72535	0.71081	0.36532	0.39604	0.06462
O04N	0	0	0	0	0	0	2.78183	1.11079	2.42207	1.11201	1.32077	0.20663
O04Y	0	0	0	0	0	0	1.59901	3.20541	1.94617	1.11926	1.11007	0.18905
O05N	0	0	0	0	0	0	0	0	5.25452	1.31725	2.62852	0.33657
O05Y	0	0	0	0	0	0	0	0	3.98955	3.88902	2.62038	0.55018
O06N	0	0	0	0	0	0	0	0	0	0	6.74627	0.58209
O06Y	0	0	0	0	0	0	0	0	0	0	5.0597	3.68657

Table 39. Fundamental Matrix (S)

Fiscal Year	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite	Total	Target
n(FY13)	0	12	6	309	280	1027	319	473	370	215	173	42	0	3227	
n(FY14)	0.82	31.03	11.84	455.21	319.49	991.35	320.12	392.70	373.66	209.45	182.05	39.27	375.06	3327	3327
n(FY15)	0.82	31.23	11.92	520.33	339.12	1067.87	308.02	344.04	374.64	202.70	188.92	37.39	746.87	3427	3427
n(FY16)	0.84	31.85	12.15	547.15	362.01	1165.88	293.02	316.25	371.94	195.61	194.20	36.10	1128.20	3527	3527
n(FY17)	0.86	32.74	12.49	565.94	389.92	1253.51	281.53	301.73	366.23	188.83	198.05	35.16	1523.16	3627	3627

Table 40. Fixed-Inventory Model

State	O01N	O01Y	O02N	O02Y	O03N	O03Y	O04N	O04Y	O05N	O05Y	O06N	O06Y	Attrite
r	0.00170	0.06446	0.02460	0.72646	0.00466	0.15479	0.00594	0.00848	0.00466	0.00212	0.00212	0	0

Table 41. Historical Accession Distributions

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